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THE PLEISTOCENE HISTORY OF THE MISSOURI RIVER[1]

ASSUMING that one whom you may honor by election to this position of vice-president is expected to bring forward something concerning his special line of research, I have chosen the theme presented as my subject. It has been my lot to study more or less for the last forty years the relations of the Missouri River to the Pleistocene Ice.

This paper proposes to set forth some facts, some of them not widely known, with theories for their explanation, and to interweave the theories with sufficient speculation to form a consistent and not improbable story.

My personal examination covers only from the mouth of the Missouri to Bismarck, N. D., consequently I speak less intelligently of the region farther north.

The Missouri is not an old river geologically speaking. It has reached maturity over most of its course, but that is the result of the softness of the rocks over which it flows, rather than of the length of time it has occupied its present course. Nor is the degree of maturity proportionate to the softness of the rocks. For example, through the Dakotas it is in very early maturity, the flood plains are narrow and the trough is narrow and has steep sides, though the rocks are very soft, while in its lower course the breadth of its trough is quite strictly proportional to the softness of the rocks forming the bed of the present

[1] Address of the vice-president and chairman of Section E, Geology and Geography, American Association for the Advancement of Science, Atlanta, December 29, 1913.

stream. This indicates that the upper part of its present source is younger in time.[2]

The fact has long been recognized that the Ohio and Missouri rivers mark approximately the southern limit of the great ice sheet of the Pleistocene, as though the latter had exercised a controlling influence in the courses of the former. The Ohio, being more accessible, has been studied by several geologists, but by none more carefully than by Professor W. G. Tight.[3]

There the general preglacial drainage was toward the northwest and was changed to the southwest. In the case before us we shall find reason to believe the preglacial

[2] Missouri Geol. Survey, Vol X., Pl. XX., and U. S. G. S. Bull. 158, Pl. XXIII.

[3] Professional Paper No. 13, U. S. G. S. (1903), "Drainage Modifications in Southeastern Ohio and Vicinity."

drainage was largely to the northeast and the ice changed it to the southeast.

The exceptional or anomalous course of the present Missouri is shown by the following facts. The Missouri at Ft. Stevenson, where it turns sharply to the southeast, is 1,720 feet A. T., while the Souris River, forty miles northeast, is 200 feet lower and from there is an open course to Hudson Bay, 900 miles away in a straight line. Instead of finding its way thither it reaches the Gulf of Mexico at just about twice that distance. To be sure other rivers show similar eccentricities, but they have mountain ranges to explain their action. Here there is nothing of that sort, but, on the contrary, only soft rocks lying horizontally. Moreover, the tendency for the Missouri to run at right angles to the direction of slope is shown further by the following facts: at Bismarck it is 220 feet higher than the James River at Jamestown, 105 miles east, and 400 feet above the Chyenne, 10 miles further east; at Pierre it is about 200 feet above the James, 105 miles east, and at Chamberlain 100 feet higher than the James near Mitchell, 66 miles east. At Sioux City the Missouri is 130 feet higher than the Des Moines at Ft. Dodge, 110 miles away, and at Council Bluffs 200 feet higher than the Des Moines, 115 miles east. At Kansas City it is about 300 feet higher than the Mississippi at Hannibal, about 200 miles east. This illustrates strikingly the tendency of the Missouri to follow the strike of the surface rather than the dip.

This anomaly is commonly ascribed to the influence of Pleistocene ice sheets. In general it is safe to suspect that the preglacial drainage of the region was toward the east or northeast. This agrees with the fact that streams along the line of the present Missouri trend eastward, except in the vicinity of glacial deposits, viz., from the vicinity of Williston, N. D., to Kansas City, Missouri.

A. THE PROBABLE PRE-PLEISTOCENE DRAINAGE ALONG THE LINE OF THE PRESENT MISSOURI RIVER

The conclusions offered here should be valued carefully according to their weight. Some may be considered fairly established; others are given only provisionally. Moreover time permits us to indicate them only briefly without stating them so fully as might be desired. The main tributaries of the Missouri are from the west and have uniformly a persistently eastward direction. Furthermore, they may be grouped into clusters of two or three which converge as they approach the Missouri, and in several cases corresponding valleys are discoverable east of the Missouri. We will consider these groups in order.

1. *The Missouri and Little Missouri Rivers.*—The upper Missouri keeps a quite persistent easterly course from the mountains till it approaches the glacial drift near Nesson, N. D. The Yellowstone flowing northward joins it 40 miles west at Buford. The Little Missouri, with a course parallel to the latter, formerly joined the Missouri at Nesson, but now it leaves its old channel about 50 miles south of its old mouth, turns east and joins the present Missouri near Ft. Berthold. In view of these facts, probably the first suggestion which comes to mind is, that before the Pleistocene the Little Missouri joined the Missouri at Nesson and both continued their way eastward to the bend of Souris River and thereby reached Hudson Bay. This seems to agree with the fact that a terrace and old channel more than 100 feet higher than the present river leads eastward over a dozen miles into the morainic drift, but such a conclusion is forbidden by the discovery of a channel corresponding in height and size several

miles southeast leading across a large bend of the Missouri in a southeast direction. This seems to show quite clearly that the Missouri occupied this channel before the ice came. If this was true it is probable that the river continued south of east to Ft. Stevenson, where the present stream turns sharply southward. Knife River joins it several miles further south, and from the direction of the valleys and the fact that there is an unusually large valley for a small stream, Snake Creek, coming in from the northeast at Ft. Stevenson, it seems possible that the Knife and Missouri formerly joined near Ft. Stevenson and ran northeast to the Souris. The divide between is heavily covered with drift and we know nothing of the preglacial surface below, but some maps show a deep notch in the east front of the divide nearly north from Ft. Stevenson and in line with the northeast course of the Souris on the south side of its great bend. The height of the Missouri at Stevenson is close to 1,700 feet A. T.; of the Souris, 45 miles away, is about 1,500 A. T.; the height of the divide between, not less than 2,100 A. T. The altitude of the terrace at Ft. Stevenson is about 1,790, which would indicate that the old channel, if there, is filled at least 230 feet with drift, which is no uncommon thickness.

The Souris at present is several feet below the bottom of the drift there, and 50 to 75 feet below the level of the Souris plain of Lacustrine origin. The surprisingly low altitude of the Souris compared with that of the Missouri is most reasonably explained by great glacial erosion of the soft rocks underlying the region. The preglacial drainage doubtless had a much gentler slope than the present surface would indicate.

2. *The Heart and Cannon Ball Rivers.*—The Heart River joins the Missouri at Bismarck at 1,620 A. T. It shows a conspicuous terrace west of Mandan, which rises 110 feet higher. Southeast of Bismarck a terrace and broad valley-like depression runs up Apple Creek to Menoken, 15 miles east, then southeast as much further, to the southwest end of Long Lake. Its bottom fluctuates a little above and below 1,750 A. T. Cannon Ball River joins the Missouri about 30 miles south of Bismarck, opposite the mouth of Long Lake Creek, which drains a valley running north-northeast, in line with the lower course of Cannon Ball to the west end of Long Lake, and to the valley already mentioned as coming from Bismarck. Long Lake occupies a valley 25 to 30 miles long and 4 or 5 miles wide, continuing in the same direction, past Dawson, on the Northern Pacific railway, until it becomes filled with glacial deposits and untraceable. The altitude of the bottom of the valley near Dawson is 1,738 A. T. A lobe of the ice of the Wisconsin stage pushed up this valley as far west as Sterling. We have, therefore, quite convincing evidence that Heart and Cannon Ball rivers, at some time, most probably in preglacial times, flowed over the present divide between the Missouri and James rivers. Their course further east has been obliterated by the marked erosion and deposition of the various ice sheets, which have successively occupied the region further east.

3. *Grand and Moreau Rivers.*—The Grand River turns southeast before reaching the Missouri, apparently to go around the south end of a high ridge which lies just east of the latter stream. The Moreau probably joined it near this point not far from Mobridge. Both streams have several terraces along their valleys; those about 200 feet above the present stream are prominent and correspond to a broad valley which runs northeast 20 to 25 miles, where the surface becomes morainic and

rises gradually to the lowest point of the divide below the Missouri and James near Hillsview, at an altitude of 1,850 A. T. Thence is a gradual descent to the valley of the James near Aberdeen. That the axis of a lobe of ice lay along this line during the Wisconsin stage is shown by hills lying to the north and south, and these with the before mentioned ridge lying along the east side of the Missouri are all covered with morainic drift. It is not difficult to conceive that the preglacial Grand and Moreau, flowing 200 to 250 feet higher than now, went east to the James.

4. *Cheyenne and Bad Rivers.*—These constitute another pair which, probably uniting near Pierre, passed east to the James River Valley. The Cheyenne at that time lay further south in its lower course, as is indicated by broad high terraces. It passed south of Sully Buttes and eastward through the northern part of Hyde and Hand counties and the valley of Turtle Creek to the James near Redfield. Bad River may have joined it near the mouth of Okobojo Creek or may have followed the present course of the Missouri to the mouth of Medicine Knoll Creek and up its course to a junction in eastern Sully county. There is similar and clearer evidence of a former ice lobe here than that found in the last case, viz., the moraines to the north and south and along the east bluffs of the Missouri. The valley is so well marked that it is popularly known as the Ree Valley. The hills north and south rise to 2,000 A. T. The lowest part of the divide in the valley is 1,650 to 1,675 A. T. The depth of the glacial drift may reach 200 to 250 feet.

5. *White River.*—The course of this river is about as easily traceable east of the Missouri as that of Heart River, and for a similar reason, viz., because the ice did not quite reach to the Missouri in its valley. There are several prominent terraces along White River, one 200 to 250 feet above the stream. At about the same level is a valley about two miles wide which runs from the mouth of that river northeast nearly 25 miles, where it is crossed by a moraine a little west of White Lake. White Lake may be considered in it and the depression continues down the Firesteel to the James, and then northward to join the Cheyenne. Red Lake occupies a portion of this same valley. Several miles south of White River is the old divide between it and Niobrara River. It stands out prominently as a high range of flat-topped buttes capped with Tertiary sandstone. The gorge of the Missouri through it is 750 feet deep. The preceding rivers after reaching the James Valley, which was then imperfectly developed, converged to a point northeast of Aberdeen, where there is a prominent gap in the highland east of the James, a little north of the south line of North Dakota. It is the wide valley of an intermittent stream called the Wild Rice River. That stream heads close to the James River and the divide between is not over 30 feet higher than the latter. The Wild Rice descends 300 feet in 60 miles and joins the Red River of the North.

We may conclude, therefore, that White River turned northward, joined the Cheyenne near Redfield and Grand River north of Aberdeen and met the Cannon Ball and Heart rivers coming from the north and all formed an important stream which found its way eventually to Hudson Bay, as Red River does to-day. It is possible that the two from the north may have found courses along the Cheyenne and not joined those from the south till later. No trace of the old courses could be found now, for the erosion of the Pleistocene must have lowered the surface scores of feet below the bottoms of the old valleys.

6. *Niobrara River.*—The valley of this

stream as late as just before the Wisconsin stage of the Pleistocene has been clearly traced from a little south of its present junction with the Missouri, northeast past Springfield and Tabor, to the James a few miles northeast of Yankton. There is little doubt that its preglacial course was the same so far. Its altitude was probably 100 to 150 feet above the present, *i. e.*, 1,300 to 1,350 A. T. It may have been 100 feet higher still. That it belonged to a different system from those hitherto considered is favored by the following facts: (1) there is trace of an old divide crossing the James River south of Mitchell. The Sioux Quartzite rises to more than 1,200 A. T. and Cretaceous rocks overlive to a height of more than 1,300. As this is in the center of the valley it is reasonable to think that 100 feet may have been carried away by glacial erosion. (2) There is a line of high ridges lying across the James valley north of the Niobrara, as though they were a remnant of a divide. I refer to the Choteau Creek Hills, James Ridge and Turkey Ridge. (3) The few traces of preglacial surface in eastern Nebraska and western Iowa seem to call for a lower drainage level than is indicated farther north, and also farther south. In short there seems to be need of finding a drainage outlet eastward to the Des Moines, or else to postulate a recently formed syncline for which we know no other evidence.

We conclude therefore that the Niobrara turned south and followed the courses of the James and Missouri to the vicinity of Onawa, Iowa, thence east and northeast through Ida and Sac counties past Wall Lake and thence southeast along the Raccoon River.

This conclusion rests on a few apparently reliable reports from wells which show that the preglacial surface indicates a valley whose bottom is less than 900 A. T., in some cases less than 850. It has not been possible to outline the valley throughout, but half a dozen observations through Ida and Sac counties are most easily explained by such a theory. The fact that Wall lake lying on the summit formerly drained into Boyer River and now into the Raccoon, and another fact that the Boyer rises east of the crest of the divide, has first a course east of south and at this point turns southwest, are also most easily explained by the theory given.

There was a descent of about 350 feet from Sioux City to Wall Lake.

7. *Platte River of Nebraska.*—This stream presents difficulties which have not yet been satisfactorily solved. The lowest surface overlain with glacial deposits in their original position seems to be about 970 feet A. T. in the vicinity of Omaha and Council Bluffs. The lowest striated rock surface is about 1,000 A. T., except a ledge at Omaha reported by Dr. C. A. White, which was about 6 feet above the river, and may have been the result of the action of river ice. It is conceivable that till may have slumped 30 feet into more recent excavations without clearly showing the fact. There are numerous evidences of such slumping elsewhere along the trough of the Missouri.

Now there seems to be quite clear evidence, as will be explained in the next section, that in early Pleistocene there was a divide at least 900 feet A. T. near Leavenworth and that south of it drainage levels were considerably higher than north of it. There would, therefore, have been insufficient slope in that direction to have excavated down to 970 feet A. T. 150 miles away. We seem driven therefore to find some other outlet.

Could it have been through to the Des Moines by the old channel in Sac county? That would have had a steeper grade than by Leavenworth. We have not been able

to find any other route to the Des Moines half as probable, but it has been argued elsewhere[4] that eastern Iowa was formerly relatively considerably higher than now.

Could it have been southeast to the Grand River of Missouri? From the mouth of Platte River to a point in Grand River of equal altitude to the Missouri at Leavenworth is considerably shorter than to the latter point. It is quite possible that Grand River was not much higher in preglacial time than now. The region has not been examined with reference to this problem, but there is nothing in the course of present streams nor anything reported concerning the geology of that region which suggests that the Platte ever followed that course. We must therefore leave the problem not definitely solved, though the second hypothesis seems on the whole the more probable.

8. *Kansas River.*—The preglacial course of this stream is known to have followed nearly its present course but from 125 to 150 feet higher than now. This is shown by stretches of chert gravels with no admixture of northern erratics, such as the glaciers brought into the region. We may conceive that it followed the course of the Missouri from Kansas City to the vicinity of Miami and thence southeast by Salt Fork to the Lamine River and back to the Missouri again. If the Platte reached Grand River it would here have joined the Kansas.

From the distribution of the drift and loess in Missouri I argued some years ago[5] that the Osage in early Pleistocene did not join the Gasconade but turned north by the present course of Auxvasse Creek and over into Salt River and so to the Mississippi. It does not seem very probable, though not clearly forbidden by known facts. The upland between rises to 870, and there is no trace of divide between the Osage and the Gasconade, nor are they different in depth and age, as we should expect, if they had been separated till recently. The other alternative is to suppose that its course was down the present Missouri to its mouth, and that the shallow valley along the line of the Auxvasse and Salt Fork is due to general erosion acting on softer rocks, rather than to the presence of a master stream.

[4] *Kan. Univ. Sci. Bull.*, Vol. VI., p. 375.

[5] Mo. Geol. Survey, Vol. X., pp. 200 and 212.

B. THE MISSOURI DURING THE NEBRASKAN STAGE

We now proceed to consider the probable history of the Missouri during the successive stages of the Ice Sheet of the Pleistocene. The stages usually recognized are in order: Nebraskan, Kansan, Illinoian, Iowan and Wisconsin, with substages of the last Altamont, Gary Antelope, etc., corresponding to the principal moraines left.

We know little of the Nebraskan Stage except that the ice did not then extend so far as the Kansan and that its deposits have been mostly carried away or hidden by the ice of the latter stage. The ice advancing from the north gradually pressed southward up the Red River valley, and dammed the master stream, formed of the streams we have enumerated as flowing northeast from the present James River valley, and caused an overflow into the Des Moines valley. Later it closed up their entrance into the Red River valley from the west, and caused the Missouri, Cannon Ball, Grand and Cheyenne to become a lake, and to overflow whatever divide separated them from White River, and eventually to overflow the divide separating them from the Niobrara, outlining for the first time the course of the James River.

Meanwhile, the ice passed more freely southward in the Des Moines valley, filling it and forcing the Niobrara to overflow what ever divide separated it from the

Platte, and compelling all the streams mentioned to find their way around the edge of the ice southward, probably along the line of the present Missouri, or a little west of it, from Sioux City to Nebraska City and quite likely for a time through the Grand River of Missouri.

We are assured that the ice entered eastern Nebraska and reached to the south line of Iowa. In Dakota, it probably did not enter the James River valley extensively, for the gap by which it entered was probably narrow and its axis at right angles to the lobe which filled the Red River and Des Moines valleys.

C. THE MISSOURI DURING THE KANSAN STAGE

After a recession, we know not how far back, the ice advanced again to its maximum extent. The ice filled the Des Moines valley again, and overflowed southward to central Missouri, westward to Lincoln, Neb., and southwest to Topeka, Kan. As it crowded the great stream which skirted its edge, for the first time it overflowed the divide separating it from the Kansas, at Weston, Mo., a little north of Leavenworth. This fact is recorded in a stratum of boulders, nearly 20 feet thick and extending for miles along the bluffs east of the river. It rests on Carboniferous shales which rise about 140 feet above the present river. Among the boulders are scattering ones of northern origin attesting the vicinity of the ice sheet. Of course, when the ice reached Topeka, that locality of Weston was deeply buried with ice, and the master stream was forced much farther westward, as we shall see.

Meanwhile, the lobe entering the James River valley found, no doubt, a freer access because of the erosive work of the earlier ice lobe and of the streams attending it, for they worked on soft material. The latter must have been quite large, for they drained the western edge of the ice quite extensively. Besides, the head of the ice behind was probably higher than before and the push forward stronger. Moreover, because of the latter condition, the ice overrode the divide to the north more, and the push was more southward than before, so that in this Kansan stage the Dakota ice lobe reached perhaps as far south and west as West Point, Neb., and became confluent with the west edge of the Minnesota-Des Moines lobe for hundreds of miles.

As the ice advanced in the James River valley the surrounding streams had to shift laterally westward and when dammed rose and overflowed local divides, working their way southward around the ice. The Missouri River entering the James River valley from the north, probably with the Souris, skirted the western edge of the ice, through the Dakotas to the Niobrara, being successively augmented by the various streams before mentioned from the west. Reaching the Niobrara it first followed it eastward to the vicinity of Sioux City, but later as the Dakota lobe crowded against the highlands of northeastern Nebraska, the river was choked off and, being dammed, it formed a deep lake, reaching far north along the western edge of the ice and eventually overflowed southward from the south bend of the Niobrara, past Creighton and Plainview, where the channel is still traceable, to the Elkhorn.

So also farther south, the stream was pushed westward by the advance of the Kansan ice from the former course along the east line of Nebraska, to a line along Logan, Elkhorn and Platte rivers, and possibly for a short time over the divide into the Nemaha to its earlier course through Missouri.

But eventually when the ice reached its maximum, the stream from the Niobrara before sketched crossed the line of the Elk-

horn at Norfolk, went up Taylor Creek, over the divide south at Creston, to the Platte, and over the divide south of that, near or east of David City, into the Big Blue. From there the course is clear.

The course from the Elkhorn to the Big Blue is largely conjectural. There may have been no distinct channel much of the way, for any considerable time. Drift deposits in Nebraska seem more than usually of a stratified or banded character especially toward the margin. There may have been extensive shallow lakes over much of the way.

Some present altitudes along this course will be instructive. Through the Dakotas, the altitude may have been 1,600 to 1,700 feet; Plainview is 1,683, Norfolk, on the Elkhorn, 1,525; Creston, 1,604; Schuyler on the Platte, 1,350; David City, 1,607; Millerton, on the Big Blue, 1,590. It may possibly have reached the Big Blue by Skull Creek and Oak Creek passing a little west of Lincoln and over the divide near Berks, without finding an altitude over 1,500 A. T.

After reaching the Big Blue the course was clear. The course was unobstructed to the Kansas at Manhattan, Kan., and eastward by the latter stream around the ice to the Mississippi. So at first, but as the ice continued southward it for a time dammed the Big Blue, a little below Blue Rapids, Kan., forming a short-lived lake which covered the eastern half of Washington county, Kan., and possibly at about the same time formed a similar lake, Kaw Lake as it has been called, in the valley of Kansas River, by filling the trough of that stream with ice from Wamego to Lecompton, a distance of more than sixty miles. Kaw Lake, soon filled and found an outlet over the divide south 200 feet higher than the present stream, and from the valley of one small tributary of the Kansas to another, till southeast of Topeka it reached the valley of the Wakarusa, which conveyed it around to the valley of the Kansas below the barrier. At Kansas City the ice sheet crowded against the heavy limestone ledges in the northern part of the city, while the river occupied the valley in the southern part of the city, which leads eastward to the Missouri again.

This course was occupied through Kansas long enough to cut down quite a channel and to pave it with boulders and gravel, before the recession of the ice opened up the channel of the Kansas again.

D. WHILE THE KANSAN ICE WAS RECEDING

Though the ice sheet of the Kansan stage seems not to have paused in any one position long enough to form a marginal moraine anywhere, its advance and recession must have been very slow. After the Kansas resumed its preglacial course it cut down considerably before it ceased to receive the drainage of the ice, or before main drainage of the ice had shifted back to the line of the present Missouri, south of Dakota.

Omitting many details that might be given in the progress of shifting, I will simply give one which has been studied.

When the Kansan ice was at its maximum, the master stream of drainage flowed past Plainview at an altitude of 1,683. As the ice receded to the east and north the stream found a way at a lower level along the edge of the ice for several miles and then over the divide at Coleridge at 1,552, and then down Logan Creek. This allowed the rapid lowering of the water in the temporary lake in the Niobrara, and caused the deposition of much gravel along the line. As the ice receded farther the stream followed the ice front till it reached the line of the former course of the Niobrara, which passed northeast from its present

junction with the Missouri and joined the James several miles north of Yankton.[6]

At this point we may offer a word concerning the loess. This problematic deposit covers the Kansan till almost universally. The surface of the latter is generally much eroded, and because of this it has been argued that a long time elapsed between the deposition of the two formations. It was once claimed that the loess was largely of Iowan age, but it can be reasonably questioned whether erosion might not have been rapidly accomplished by the waters closely attending the edge of the ice, while the loess may have been deposited in flooded streams and local lakes remote from the edge. This silty material has doubtless been further modified by wind action and by later erosion and slumping. A strong objection to the flood theory, formerly felt, was the supposition that the channels of that time were as deep as the present, which we have seen was not the case. The drainage level of Kansan time was from 80 to 120 feet higher than that of the present, and it would have required scarcely a higher rise of water to have overflowed the uplands of that time than that which we shall find attended the retreat of the Wisconsin ice sheet.

E. FROM THE END OF THE KANSAN STAGE TO THE BEGINNING OF THE WISCONSIN

This was a long time during which the ice occupation of the region under consideration was not conspicuous. It corresponds to the Illinoian and Iowan advances and secessions of the ice. Elsewhere the ice found a growth into southern Illinois and far enough into southeastern Iowa to push the Mississippi westward nearly forty miles, then a recession and an advance from the northwest in eastern Iowa till the Mississippi was pushed eastward over into Rock River.

Meanwhile the ice may have lingered in northern Minnesota and Dakota and have caused greater volume to the streams than now. The course of the master stream was doubtless in the James valley approximately along the course of the present James River, and further south along the present Missouri. Erosion deepened all channels, till their bottoms approached the level of the present surfaces of the streams. The valleys were widened considerably, particularly in the soft Cretaceous formations in the Dakotas and northwestern Iowa.

F. DURING THE ADVANCE OF THE WISCONSIN ICE

As in earlier stages the Minnesota and Dakota lobes of ice were the only ones advanced southward along the same lines which affected seriously the Missouri. They advanced southward along the same lines as before, and though probably with greater velocity and vigor, yet they did not attain so great extent. This may be explained possibly by a warmer climate than in former advances. The Minnesota lobe reached only to Des Moines, Iowa. The Dakota lobe only to the south line of South Dakota, although it pushed farther westward than before up the valleys of the western tributaries. Why this should be is not very evident. Possibly because of the greater depth and width of the trough of the Niobrara River where it was transverse to the paths of the ice, and because of the greater volume of water skirting the ice front there on the south. On the west, however, the greater maturity and therefore the greater width of the valleys of the western tributaries, like the White, Cheyenne and Grand, enabled the ice to push westward easier than before. At any rate the de-

[6] *Bull. G. S. A.*, Vol. 23, pp. 463–470.

posits, moraines and till, show that the ice pushed westward up each of the valleys nearly to the line of the present Missouri. In other words, the ice filled the present James River valley so completely that all the western streams were dammed and the waters rose in each till an outlet was found southward. Between the Missouri and Cannon Ball and Grand rivers the divides were low and of soft material. But between the Grand and the Cheyenne was a prominent ridge capped with Fox Hills sandstone rising over 2,000 A. T. North of this was formed Lake Arikaree, reaching up the line of the present line of the Missouri to or beyond the mouth of the Yellowstone. Into it at several points the ice sheet at its maximum dropped small icebergs, by which boulders were scattered over the bed of the lake, and particularly on its southern margin, which is now in places marked by a line of boulder-capped buttes and ridges apparently corresponding to an old water level or lake margin.

The divide between the Cheyenne and White rivers was again comparatively low, but that between White and the Niobrara was again high, nearly 2,000 feet A. T., and capped with Tertiary sandstone. Through this an outlet was started which now is an imposing gorge, 750 feet deep. The ice also blocked the Niobrara from Springfield to Yankton, but did not force it over the divide southward as during the Kansan stage. Instead the river was crowded up on the south side of its valley where it excavated so deep a channel before the retirement of the ice that it became permanent.

So we have the present course of the Missouri from Ft. Stevenson to Yankton as a direct result of the Wisconsin stage of the ice sheet, as the course from Sioux City to Nebraska City was probably determined by the Nebraskan stage and from Nebraska City to Kansas City and possibly to its mouth by the Kansan stage.

G. DURING THE RECESSION OF THE WISCONSIN STAGE

The Wisconsin was the last great invasion of the ice sheet, and its recession was long and marked by long pauses, when belts of knobs and ridges of débris were dropped from the nearly stationary edge of the ice. The first of these and the most voluminous was formed a few miles within the maximum extent of the ice. Before the next was formed there was recession far within the line of the second moraine and then an advance and a pause to form the second moraine. So that the Wisconsin stage had many substages similar to the stages already reviewed except that they were shorter and with ever-waning extent. During the recession from the first moraine there was the unloosing of great volumes of water as there was at the close of the Kansan, laden with much sediment, coarse and fine. The coarse dropped near the edge of the ice-formed valley trains, the fine, carried far, formed a deep accumulation of silt, particularly in broader and stiller portions of the streams. Such deep deposits are found well-preserved at many points. Their upper surface seems originally to have been nearly flat like a river terrace, but is now not only deeply eroded, but is more or less increased in height by the wash from the upland back. The lower limit is of course uneven, but usually is only a few feet above the present level of the streams. This deep silt and sand deposit is frequently from 80 to 120 feet deep. It closely resembles the loess often found on the uplands in the vicinity. In fact they have often been confused, nor is it any wonder.

This lower loess or early Wisconsin flood deposit is finely exposed at Kansas City,

Kan., also in the bench along the north side of Kansas City, Missouri. At Leavenworth, St. Joseph, and south part of Sioux City, besides several less conspicuous points between, and further down the river. Similar deposits are found in the lower part of the Kansas River near Edwardsville, Holliday and Bonner Springs. Here it is due to back water from the Missouri, and the character and color differ from those of the Missouri River deposit.

After considerable examination I have no doubt that the similar terraces in western Iowa along the streams which headed near the edge of the Wisconsin ice are to be referred to the same cause. I refer to the terraces on the Boyer, Soldier and Maple. The absence of such along Mosquito, Nishnabotna and Nodaway confirms this conclusion. They were too far away to share in the floods from the Wisconsin ice.

Similar floods may have attended similar recessions from later moraines, but they were less effective, and after the third or fourth the ice retired too far away to affect the Missouri notably. Numerous lower terraces are found along the Missouri and its tributaries, which record such stages which attended the gradual deepening of their channels in the 15,000 or 60,000 years since.

In the recession of the ice, glacial lakes were formed from time to time. Lake Dakota was formed in the central part of the James River valley, while the fourth moraine was forming. It became nearly filled with a fine silt closely resembling loess.[7] Later Lake Agassiz occupied the Red River valley, but it was beyond the scope of our subject.

I leave the subject with you. If I have made any point clearer or suggested a thought which may lead to further light I shall be well satisfied.

It may gratify our national pride a little to see how cleverly nature, not long ago, changed so much of the drainage which was sweeping the rich soil of our great plains into the British dominions, so that it was permanently diverted into our borders.

From this sketch, we see how nature has wrought the course and character of the greatest stream on earth, and one of the most important. It may not be called as historic as others, for its history is yet to come. Who can doubt that it is destined to be associated with some of the mightiest and most far-reaching events of the future,

J. E. Todd

University of Kansas

[7] *Iowa Acad. Sci.*, Vol. XIII., p. 187.

BENJAMIN OSGOOD PEIRCE

The death of Professor Benjamin Osgood Peirce at Cambridge on January 14 removes before his time one of the most valued members of the Harvard faculty and one of the most scholarly of American physicists. Having been asked by the editor of Science to contribute an obituary note, although feeling that one of his colleagues could do it in a more accurate manner, I could not forego the melancholy satisfaction of paying a personal tribute to the best of teachers and the cherished friend of thirty years. Peirce came to Harvard as instructor in the same year as the writer as a freshman, and the admiration he then inspired has only grown with years.

Peirce's first ancestor in America was Richard Norman, who came to Gloucester in 1623. His great-grandfather, Benjamin Peirce, was killed at Lexington. From him was also descended Benjamin Peirce, the distinguished mathematician. On his mother's side Peirce was descended from ship-owners in Salem. Born on February 11, 1854, at Beverly, it was from such sterling stock that Peirce inherited the New England conscience and capacity for thoroughness which were his leading characteristics. He received an excellent preliminary education in the schools of Beverly, and afterwards prepared himself for college, with plenty of Latin, Greek and mathe-

matics, then, as now the best training for a scientist, and he never forgot them. Neither did he slight the modern languages nor the vernacular, for nothing but the best of English ever proceeded from his mouth or pen.

Graduating at Harvard in 1876, he had already shown a marked talent for both mathematics and physics, and, receiving a traveling fellowship, he proceeded for further study to Leipzig, where he worked in Wiedemann's laboratory, and obtained the degree of Ph.D. in 1879. After this he spent another year at Berlin with Helmholtz, from whom he drew much inspiration. During these four years he had not only obtained skill in experimental research, but he had obtained a thorough grounding in the principles of mathematical physics, then almost entirely untaught in any American university.

Returning to the United States in 1880, Peirce spent a year in teaching at the Boston Latin school, and in 1881 received the appointment of instructor in mathematics at Harvard. This was not what he desired most, but he took hold of the work with enthusiasm, and among other subjects taught the calculus in a two-years' course, alternating with Professor Byerly. A splendid course it was, and those students who took it under one disputed with those taking it under the other as to which was the better teacher. But the most notable course instituted by Peirce and shared by this pair of masterly teachers was that one in which Peirce treated the theory of the Newtonian potential function, and Byerly the theory of Fourier's series. The writer well remembers his feeling of mystification, when at the end of his freshman year, on consulting the elective pamphlet to select courses for the next year, he came across the announcement, Arbitrary Functions and the Theory of the Potential. What on earth were arbitrary functions, and what was the "potential"? His highly respected teacher in the high school, hitherto an unfailing adviser, could not tell. But as a matter of fact this course marked a new era in American university work, for, as has been stated above, the teaching of mathematical physics in this country was practically non-existent. I say this advisedly, having in mind that mechanics was taught to a certain extent, and that there were one or two courses on the theory of light, but the character of the teaching was totally different from that of the present era. Peirce had come back from Germany full of enthusiasm for the thoroughgoing German methods and the magnificent achievements of Gauss, Riemann and Dirichlet, which had opened up to him a new world. The backbone of theoretical physics is the subject of partial differential equations, and the most suitable gate to enter by is the theory of the potential belonging to forces acting according to the law of the inverse square. This Peirce had the insight to perceive, and made it his part to work up a course on this subject, which he treated with rare clearness and skill. The subject-matter of this course afterwards appeared in his treatise "Elements of the Theory of the Newtonian Potential Function," which passed through three or four editions and constituted a model of what such a work should be. One other of the fruits of his teaching was the short table of integrals, whose convenience has brought him the gratitude of many a student of the calculus.

In 1884 came the appointment as assistant professor of mathematics and physics, and Peirce took his place in the department of physics, to which he rightly belonged, and in which he was able to do his share in the reconstitution and modernization of that department which it was now to undergo in the new Jefferson laboratory. This was at the beginning of systematic laboratory work in physics in this country, and there was a certain amount of friction in getting the new ideas started. In 1888 with the retirement of Professor Joseph Lovering he was succeeded by Peirce in the Hollis professorship of mathematics and natural philosophy, a decided honor for so young a man. At the same time Professor John Trowbridge became director of the laboratory, and from this time on there was a rapid development of the laboratory work into what has become one of the best organized courses in the country, while re-

search was for the first time recognized and encouraged. Peirce took for his field the development of the laboratory course in electricity and magnetism, which he brought to a high degree of efficiency and interest. At the same time he devoted a large part of his powers to the graduate courses on mathematical physics, particularly the theory of electricity and magnetism and hydrodynamics. Besides this he threw himself vigorously into the prosecution of research, which he kept up with unabated assiduity until the end. Without going into these researches in detail, it will suffice to say that they were probably about fifty in number, and of considerable variety. Beside those on various subjects of mathematical physics, the experimental papers nearly all required an unusual amount of mathematical theory. Most notable are the researches on the thermal conductivity of various kinds of stone and its variation with temperature, in which he had the collaboration of his friend R. W. Willson, and his researches on magnetism, on which he was still engaged at the time of his death. Both these subjects are of extreme difficulty, and to them he devoted his best efforts, combining remarkable experimental skill with the mathematical knowledge necessary for their treatment. It was this rare combination that characterized the success of Peirce's work, and made him such a valuable colleague. It was said by one of his colleagues that he knew more physics than any other member of the department of physics, and more mathematics than any other member of the mathematical department, and the statement was not contradicted by any of them.

But this devotion to work, while producing most satisfactory results, was not without its penalty, for the inevitable result of overwork was a nervous breakdown, to which he was obliged to give way nearly a dozen years ago, and to take the much-needed year of rest in Europe. Unfortunately it was too late, and one year was not enough. Although he recovered sufficiently to resume his work, eventually at his normal pace, he really never recovered, and the rest of his life was a brave fight against ill-health, carried on against tremendous odds, with a cheerfulness which deceived many. For years he suffered from insomnia, and at last the mechanism was entirely worn out, and after an extremely painful illness borne with great fortitude he succumbed to an attack of angina pectoris.

But it was not alone his scientific work that made Peirce such a source of strength to the university, it was the influence of his rare personality that drew to him hosts of friends among students and colleagues. Absolute self-abnegation and devotion to duty were the keynote of his character. With him modesty was so excessive as to almost cease to be a virtue. When consulted by a colleague with regard to some difficulty, almost invariably his first response was that he did not know anything about the subject, and it was necessary to draw him out with insistence in order to get at his superior knowledge. He was always fearful of giving trouble to some one, and frequently lay awake at night worrying over the troubles of others, never his own. Always cheerful and ready with a joke or anecdote, he was the kindest and sanest of advisers. Possessed of a sure and childlike religious faith, he was almost a Puritan in the conduct of his own life, but absolutely sympathetic and charitable toward others. Only himself he did not spare. Often his friends would remonstrate with him against his risking his health by overwork, but it was impossible to get him to desist. His teaching was characterized by the greatest clearness and infinite pains. Everything that he did was done with elegance and neatness. Often the writer has marveled to see the beautiful drawings that he made to illustrate his papers, the curves being laboriously cut out in zinc for greater accuracy. He kept a font of mathematical type in the laboratory, and set up many of the complicated formulæ in his table of integrals with his own hand. Though a thorough Yankee, he had a broad knowledge of Europe, spending much time in England and Scotland, and never forgetting his precious years in Germany. He was a great reader, and was extremely well informed

on a wide range of subjects, never giving up his interest in the classics. In every way Peirce was a living example of that breadth of character and interest which has so often been characteristic of great scientists, but which the specialist is so commonly supposed to lack.

Peirce's scientific activity was rewarded with many distinctions. In 1906 he was elected a member of the National Academy of Sciences. He was also a fellow of the American Academy of Arts and Sciences and of the American Philosophical Society, member of the American Mathematical and American Physical Societies, of the Astronomical and Astrophysical Society of America, the Société Française de Physique, and the Circolo Matematico di Palermo. He was one of the founders of the American Physical Society, and was last year elected its president. The election would have been renewed this year, but just before the meeting Peirce, evidently feeling his inability to discharge the duties of the office, had a notice sent out urging members not to vote for him. Unfortunately his misgivings were justified. In 1910 Harvard conferred upon him the degree of Doctor of Science.

Professor Peirce married, on July 27, 1882, at Edinburgh, Scotland, Miss Isabella Turnbull Landreth, by whom, with two daughters, he is survived. At his funeral Appleton chapel was crowded with colleagues and students, but the number of friends who will never forget his influence is far greater than could be contained in any building.

ARTHUR GORDON WEBSTER

THE BRYANT WALKER EXPEDITION, OF THE UNIVERSITY OF MICHIGAN, TO THE SANTA MARTA MOUNTAINS, COLOMBIA, IN THE SUMMER OF 1913

THIS expedition, sent out from the museum of zoology, was organized to do zoological work in and about the west end of the Sierra Nevada de Santa Marta, in northeastern Colombia. The plan of the work was that adopted for all expeditions sent by the museum to regions outside of the state of Michigan. Relatively small areas where a variety of conditions prevailed were located, and these were examined for those groups of animals to which the members of the museum staff are giving most attention. Particular study was made of the habits and local distribution of the species, and the results were preserved as specimens, notes and photographs of specimens and environments.

The party consisted of A. S. Pearse, of the University of Wisconsin, F. M. Gaige, of the University of Michigan, and the writer (in charge); and the groups which received most attention were the reptiles, amphibians, ants, crustaceans and molluscs. The collections of these forms may be summarized as follows: reptiles and amphibians, about 1,000 specimens; ants, 603 lots; crustaceans, 140 lots; molluscs, 150 lots. Small collections of other groups were made by preserving such material as was discovered, the collecting being restricted to a few forms which could be secured in series without interfering with the regular work. The groups which received such attention are leeches, earthworms, myriapods, scorpions, beetles, the genus *Peripatus*, and fishes. The other material secured consists almost entirely of specimens of those forms needed for illustrative purposes or as additions to the synoptic collections in the museum.

The expedition reached Santa Marta on July 1 and at once proceeded to an elevation of 4,500 feet. From this point a strip of territory from 2,200 feet to 8,300 feet (the summit of San Lorenzo) was explored for twenty-six days. On July 27 the party moved to the plain and spent nine days in continuing the explored strip from 2,200 feet to the foot of the range. The remainder of the time until September 1 was given to the investigation of the lowlands in three places—about Santa Marta, at Fundacion and on the Salamanca coast near Cienaga.

Not a little of the success of the expedition is to be attributed to the assistance and hospitality of Mr. and Mrs. O. L. Flye and the members of their family, Mr. and Mrs. M. A. Carriker, Mr. William A. Trout, consular agent

at Santa Marta, and Mr. Robert Sargent, Americans residing near Santa Marta. Through their efforts the party was provided with splendid facilities for field work and received substantial assistance in gathering material. The Colombian government permitted the free entrance of the equipment.

The collections of the expedition are now being studied by a number of investigators, and the results will be published from time to time as the studies are completed.

Alexander G. Ruthven
Museum of Zoology,
University of Michigan

THE PRESIDENT OF THE UNIVERSITY OF ILLINOIS

A correspondent at the University of Illinois asks us to print the following communication:

In order to ascertain whether or not a persistent rumor that he had not the support of the faculty, was true, President Edmund J. James, of the University of Illinois, submitted the matter to a referendum vote of those of the faculty elected for two years or longer. The result was overwhelmingly against the rumor—188 expressing confidence in the president as against four who voted in the negative. At a later meeting a vote of instructors and assistants—those holding positions of one year tenure—revealed an even greater degree of confidence, but one disenting voice arising. The latter meeting was called on the initiative of the men themselves.

The procedure was unique in American universities. Indeed the American university system has been criticized to the effect that the president or head has the power of an autocrat. Autocratic power, all history shows, is unsafe in any man's hands, as it soon becomes too dear to his heart. Therefore when a man elected to the presidency of a great university voluntarily submits the question of his own efficiency to the vote—a secret ballot—of his force, the act has signal significance.

During the ten years that Dr. James has served as president the university has made phenomenal growth in revenue, equipment, faculty, attendance and general standing. The commonwealth has been liberal; trustees, members of the faculty, alumni and other friends of the university have cooperated heartily in bringing about this result. The president felt, naturally, that he also had been a factor in this upbuilding, that unless this was so after ten years of persistent and laborious work, his presence in such an institution as its head was a mistake. As a consequence he submitted the following to a referendum vote of the faculty: "I want to know whether in your opinion my administration as president of the University of Illinois during the past ten years has been liberal and progressive, and has promoted the substantial development of the institution on broad and scholarly lines, and whether as president I have the regard and cooperation of the faculty. On this proposition I ask you to vote either yes or no."

The result on a secret ballot was, as stated above, 188 to 4, in favor of confidence in the president.

Previous to this endorsement by the faculty the Illini Club of Chicago, consisting of 1,000 graduates, had expressed to the president their most unqualified approval in a set of resolutions passed at its annual business meeting.

Following this the pastors of some nineteen churches in the twin cities of Urbana-Champaign, including the Y. M. C. A.'s, Methodists, Catholics, and practically all denominations represented in the cities, sent a special delegation bearing a series of signed resolutions to President James expressing their confidence in him and their pleasure in the many evidences of the university's progress.

Still later the Alumnæ Association of Chicago addressed a letter to President James saying among other things. "It is the earnest hope and wish of every member that you continue to serve as president in the work which has made possible the constant growth, the increasing influence and the general development of the University of Illinois."

THE CARNEGIE INSTITUTION EXPOSITION TO TORRES STRAITS

The expedition of the department of marine biology of the Carnegie Institution of Washington has returned from the region of Torres Straits where it visited the islands between New Guinea and Cape York, Australia, remaining for the greater part of the time upon Maer Island, one of the Murray Islands, on the outer edge of the Great Barrier Reef south of the Bligh Entrance.

In response to Ambassador Bryce's letters of introduction the Governor of Queensland and

of New Guinea received the members of the expedition with a courtesy and kindness which contributed materially to its success.

The expedition was under the leadership of Dr. Alfred G. Mayer, with whom were associated Dr. Hubert Lyman Clark, of Harvard, Dr. E. Newton Harvey, of Princeton, Frank A. Potts, of Cambridge University, Professor D. H. Tennent, of Bryn Mawr College, and Mr. E. M. Grosse, of Sydney, whose excellent colored drawings served to illustrate the living aspects of the echinoderms which were collected by Dr. Clark.

The expedition was well equipped with apparatus and provided with a naptha launch, Mr. John Mills, of the department of marine biology, being the engineer.

For littoral echinoderms there is probably no richer region in the world than that of the Murray Islands, lying as they do about 70 miles south of New Guinea and within 6 miles of the outer line of the Great Barrier Reef of Australia. At Maer Island alone Dr. Clark collected about 150 species of echinoderms, and about 100 of these were beautifully figured by Mr. Grosse. Clark also found that crinoids are more active than has been generally supposed, some species being able to swim actively through the water.

Professor Tennent succeeded in effecting a cross between a male crinoid and the echini, and at Badu Island he obtained abundant material upon echinoderm crosses for an extensive cytological study.

Dr. Harvey found a holothurian, certain living pigments of which change purple in alkalis and red in acids, and he was thus enabled to determine the relation between the rate of penetration and the degree of dissociation of electrolytes.

Mr. Potts conducted several interesting ecological studies upon the habits of crustacea, and Dr. Mayer made an intensive study of the coral reefs, discovering that temperature is a factor of primary importance in determining the growth of corals. Those corals which are most resistant to high temperatures are those which are best able to withstand being buried beneath the mud, and this suggests that high temperature produces death by asphyxiation.

Certain coral beds at Thursday Island, Cape York, Australia, which were measured and photographed by Saville-Kent in 1890 were remeasured in 1913 and species of Porites and Symphyllia were found to have grown in diameter at an average rate of 1.8 to 1.98 inches per annum, or about 44 inches in 23 years.

The health of the members of the expedition was good throughout the period of their investigations, and some interesting papers may be expected to be published by the Carnegie Institution of Washington as a result of their studies.

SCIENTIFIC NOTES AND NEWS

DR. CHARLES RICHET, professor of physiology at the University of Paris, has been elected a member of the section of medicine and surgery of the Paris Academy of Sciences to replace the late Dr. Lucas-Championnière.

PROFESSOR L. MANOUVRIER, Paris; Professor Karl von den Steinen, Berlin; Dr. Alfred P. Maudslay, London; his Excellency W. Radloff, St. Petersburg, and Professor Émile Cartailhac, Toulouse, have been elected to honorary membership in the American Anthropological Association.

DR. CARL HUGO KRONECKER, professor of physiology at Berne, celebrated his seventy-fifth birthday on January 27.

OFFICERS of the Cincinnati Research Society have been elected as follows: *President,* Dr. Oscar Berghausen; *Vice-president,* Dr. E. R. Remelin; *Secretary,* Dr. J. L. Tuechter; *Executive Committee,* Dr. H. McE. Knower and Dr. Charles Goosman.

THE Syracuse chapter of Sigma Xi has initiated as non-resident members: Dr. Robert S. Breed and Dr. Ulysses P. Hedrick, of the New York Agricultural Experiment Station, and Dr. William J. Miller, of Hamilton College.

PROFESSOR C. E. SHERMAN, of the civil engineering department of the Ohio State University, has undertaken a complete examination on the summit level of the Ohio canal through

Akron, with a view to determining the availability of its waters for steam, sanitary, water supply power, and such other purposes as may be found advisable.

Dr. Georg Aulmann, assistant in the Royal Zoological Museum at Berlin, has been called to the directorship of the Natural History Museum at Düsseldorf.

Professor H. T. Barnes, of McGill University, lectured before a general meeting of the New York Academy of Sciences on February 16, his subject being "The Physical Effects Produced by Icebergs in the North Atlantic."

The Society for Biological Research of the University of Pittsburgh held its first open meeting of the year 1913–14, on January 29, at which time Dr. Ross G. Harrison, of Yale University, addressed the society on "The Life of Tissues Outside the Organism."

Dr. Joseph Jastrow, professor of psychology in the University of Wisconsin, gave the opening convocation address at the University of Missouri on February 4, on "Theory and Practise."

Dr. Charles Sedgwick Minot, of Harvard University, made one of the addresses at the thirty-second annual banquet of the faculty and students of McGill University.

The next convocation orator at the University of Chicago will be Professor James Rowland Angell, head of the department of psychology and dean of the faculties of arts, literature and science in the university.

Dr. Wolfgang Ostwald, of the University of Leipzig, has delivered at the University of Chicago a series of five lectures on the subject of "Colloidal Chemistry."

Professor Vladimir Karapetoff, of the electrical department of Cornell University, has returned from a trip to Washington, D. C., where he delivered four two-hour lectures before the engineer officers of the United States Army, Washington Barracks. The lectures were given on February 5, 6 and 7, and the subjects treated were "Alternating Currents," "Theory of Electrical Machinery," "Design of Electrical Machinery," and "The Fundamentals of the Magnetic Circuit." Lieutenant Atkisson, who is in charge of electrical and mechanical engineering, and his assistant, Lieutenant Lampert, are former students of Professor Karapetoff's at Cornell.

The Mendelian Society of Vienna has celebrated the thirtieth anniversary of Mendel's death by opening a new institute devoted to research in heredity.

Dr. Roswell Park, professor of surgery at the University of Buffalo, a distinguished surgeon and scientific author, died suddenly on February 15, aged sixty-two years.

Dr. Albert Charles Lewis Gotthilf Günther, late keeper of zoology in the British Museum (Natural History), distinguished for his contributions to zoology, especially for his work on fishes, died on February 1 at his residence at Kew Gardens, in his eighty-fourth year.

Dr. Eduard Huber, professor of Indo-Chinese philology in the French School at Hanoi, has died at the age of thirty-four years, while engaged in an expedition to Cochin China.

Dr. Fritz Jummersbach, professor of agriculture at Munich, has died at the age of fifty-six years.

Dr. Karl Albert Neufeld, of the University of Würzburg, assistant director of the food laboratory, has died at the age of forty-eight years.

The U. S. Civil Service Commission announces an examination for technical assistant in malaria investigations to fill vacancies in this position in the Public Health Service, for duty in the field, at entrance salaries ranging from $1,800 to $2,200 a year. The duties of this position will be to conduct laboratory studies of malaria, to make surveys of malarial regions, and to advise in respect to the prevention of the disease. It is desired to secure persons thoroughly competent to make thick and thin blood smears, stain the same and identify the plasmodium of malaria in all its stages in such preparations.

The U. S. Civil Service Commission also announces an examination for geologic aid and assistant geologist, for both men and wo-

men, on March 11–12, 1914, to fill vacancies as they may ocur in these positions in the U. S. Geological Survey, at salaries ranging from $60 a month when actually employed to $1,500 a year.

COMPETITIVE examinations for the position of sanitary supervisor, New York State Department of Health, will be held in various cities throughout the state, on March 7, 1914. Open to men and women. Application blanks must be filed in the office of the civil service commission on or before March 2, 1914. The following conditions are prescribed for candidates: (1) They shall be physicians. (2) They shall when appointed be not less than twenty-eight nor more than sixty years of age. (3) They shall either (*a*) have served as a health officer of a city, town or village having a population of not less than 3,000 persons, for a period of at least four years; or (*b*) shall have received instruction approved by the Public Health Council, or a duly authorized committee thereof, in sanitary science, including five hours' instruction per week during the school year, in an educational institution, and shall have had at least two years' experience in public health work; or (*c*) shall have received a degree, certificate or diploma in public health granted after the completion of a course approved by the Public Health Council, in an educational institution, and at least one year's practical experience in public health work; or (*d*) shall have submitted proof satisfactory to the Public Health Council, or a duly authorized committee thereof, that they have actually engaged in some form of public health work for a period of at least two years. (4) They shall not be allowed to engage in the regular practise of medicine or in any other regular occupation or business; but they shall be at liberty to retain or accept other positions in public health work, such as local health officer, teaching public health and related subjects, or other kindred lines of work. The State Department of Health, however, retains the right to determine at any time whether the extent of such other work interferes with the proper performance of his duties as sanitary supervisor. The State Department of Health has fixed the salaries of sanitary supervisors at $4,000 per annum, each sanitary supervisor being required out of this sum to incur all expenditures for traveling expenses which may be necessary to enable him to efficiently perform his duties in all parts of his district.

A CONFERENCE will assemble in Rome on February 24 and subsequent days to consider the question of an international convention for the control of plant diseases and the regulation of the importation of plants. It is described as a phytopathological conference, and is to be held at the International Institute of Agriculture. About fifteen countries are expected to be represented. Invitations were issued by the French government rather more than a year ago to a conference of this kind in connection with the general assembly of the International Agricultural Institute. In view, however, of the small number of acceptances received in time to arrange the meeting, the conference was postponed for a year.

THE Vienna correspondent of the *Journal* of the American Medical Association reports that by the bequest of $300,000 under the will of the late Professor Leegen, a former member of the Vienna medical faculty, the Academy of Sciences of Vienna has obtained means to erect a special institute for physiology. The idea is to devote the institute to scientific research solely; no beginners will be admitted, and the men working there will be appointed as whole-time officers, who may *not* devote their time to any other office—as teachers in universities or hospitals. Furthermore, the academy has obtained also the Vienna Biologic Institute, together with a handsome sum to keep it going, from its founders and present owners. From this institute emanated the biological discoveries by Drs. Kammerer and Pribram and now, in connection with the above-mentioned "Leegen institute," experimental physiology on a large scale, for purely scientific purposes, will be possible in Vienna, apart from the research going on in the university laboratories.

The errors of the noon and 10 P.M. time signals as sent out by the Naval Observatory during the month of January, 1914, were as follows:

January Day	Error Noon	10 P.M.
1	−.04	−.04
2	−.03	−.03
3	+.01	———
4	+.01	+.02
5	+.04	+.04
6	+.07	+.05
7	+.07	+.06
8	.00	−.02
9	−.06	−.05
10	−.04	−.06
11	−.05	−.05
12	−.06	−.08
13	−.09	+.02
14	+.05	+.06
15	+.07	+.11
16	+.10	+.10
17	+.03	−.11
18	.00	−.03
19	.00	−.01
20	.00	−.03
21	−.01	−.01
22	−.03	−.03
23	−.03	−.06
24	−.00	+.04
25	+.04	+.07
26	+.05	+.07
27	+.11	+.07
28	+.05	+.04
29	+.07	+.09
30	−.23	+.14
31	+.16	+.19

The January number of the *Brooklyn Botanic Garden Record* contains a prospectus of courses to be offered by the Botanic Garden during 1914. There are 29 different courses, ranging from children's gardens and nature study to research work in plant physiology, mycology and plant pathology and genetics, and including courses in introductory botany, seven courses in household botany and horticulture, a course for the training of teachers of children's gardens, comprising nine different sub-courses, extending from January to October, and advanced botanical courses in plant pathology, fresh water microbiology, cytology, experimental evolution and phytogeography. In addition to the regular courses of instruction, there are also announced four courses of public lectures, two for children and two for adults, together with a statement of ways in which the Botanic Garden is prepared to cooperate with local schools in their botanical and nature study work. Classes in botany from high schools in Brooklyn are now using the equipment of the Botanic Garden, in some cases being taught at the Garden by their own teachers, and in other cases by members of the Garden staff, appointed especially for this work.

The city of Columbus and the State University have cooperated in the Columbus Horticultural Society, which is one of the oldest organizations of its kind in the United States, having been organized in 1845. The regular annual meeting was held in the new archeological and historical museum on the university campus, December 27, 1913. Professor William R. Lazenby was reelected president; H. Warren Phelps, vice-president; L. M. Montgomery, secretary; W. C. Mills, treasurer. The society has invested funds amounting to $6,000. It publishes a volume of its proceedings each year.

Some of the acacias, a group of trees with a world-circling range, are so valuable as a source of tannin and timber, says the Department of Agriculture in a bulletin recently issued, that their commercial cultivation in certain portions of the United States may prove profitable. Aside from their value for tannin and lumber, they are well adapted to the reclamation of sandy and semi-desert lands, some species being able to thrive with only three inches of rainfall. There are about 450 species of acacias, 300 of which are Australian species and the rest scattered over the world, principally in Asia, Africa and America. Australian acacias were introduced into California at about the same time the eucalypts were, and like the latter, have thrived there. Like the eucalypts they are not resistant to frost. At the present time the chief commercial value of acacias, says the department, seems to be for tanbark, although the tanbark species have important by-products. All of the leading tanbark acacias come from Australia, where they are generally known as wattles, from the fact that they were originally used for weaving and wattling the walls of huts. Actual tannin contents of the three principal tanbark acacias, as shown by analyses at the

University of California, are from 24 to 48 per cent. Oak and chestnut, the woods principally used in this country, yield from eight to thirteen per cent. of tannin. Acacia timber is beautiful in grain and durable in contact with the ground. Even the smaller species have a value for tool handles, furniture and various other useful and ornamental objects. Some of the best species yield a hard, heavy, close-grain, tough timber comparable to walnut and rosewood. In addition to tannin and timber, many of the acacias produce valuable by-products. The widely known gum arabic is derived principally from the Arabic acacia, though also from a number of Asiatic and African desert species. Cutch, an astringent gum in constant demand, is another acacia product. Many other kinds of gums are yielded by different acacia species. The flowers of still another species, known as cassie, yield a perfume, the manufacture of which at Grasse, France, the center of the perfume industry, is very profitable.

WE learn from the London *Times* that the plans of the Austrian Antarctic expedition, which it is hoped will sail from Trieste in the early summer, were set forth at a meeting held at Vienna on January 15. The principal supporter of the project is Count Hans Wilczek, to whose energies the success of the Austrian expedition which discovered Franz Josef's Land 40 years ago was largely due. Financial help is also being provided by the Academy of Sciences and the Geographical Society, but so far only about half of the required sum of over 600,000 kronen ($125,000) has been obtained. The leader of the expedition is Dr. Felix König, of Graz, who took part in the German Antarctic expedition. The ship which has been acquired is likewise that which was used in that expedition; her name, however, will be changed from *Deutschland* to *Oesterreich*. Dr. König, who is being assisted by the advice of Captain Amundsen, intends to sail from Trieste to Buenos Aires, and thence to South Georgia Island, where an intermediate station fitted with wireless telegraphic apparatus will be installed. By this means it is hoped to keep up communication between the ship, which will also be fitted with wireless, and civilization. The base is to be made close to a bay found by the German expedition in the newly discovered barrier, where it is hoped that the ship will be able to winter. The principal work will be carried out by sledge journeys, which will be made in three directions, one to the south with the object of reaching Queen Maud Mountains, the second towards Grahamland in order to try to discover its continuation southwards, and the third in the direction of the Enderby quadrant. The expedition is expected to cover two years, but provisions are being taken for three. From remarks made at the meeting by Professor Nordenskiöld the object of the expedition appears to be to discover the relations of the eastern and western section of the Antarctic regions with one another.

UNIVERSITY AND EDUCATIONAL NEWS

MRS. RUSSELL SAGE has extended her offer to give $100,000 for a new dining hall at Princeton University provided that the university raise $400,000 for the purpose.

UNDER the will of Dr. Cumberland George Herndon, two scholarships, named after the testator's father the William A. Herndon scholarships, have been founded in the department of medicine of the University of Virginia. Candidates must be unable to defray the expense of their medical education and must signify their intention of entering the medical service of the army or navy. The scholarships provide for the necessary expenses of the student during the four years of his course and will yield approximately $425–$450 per annum.

BY an agreement between the universities of St. Andrews and Bordeaux, Dr. T. Pettigrew Young, lecturer in French at St. Andrews, will proceed to Bordeaux to act as exchange professor for the month of May, while during the same period Professor Charles Cestre, of Bordeaux, will join the staff of St. Andrews University. Professor Cestre has also been commissioned by the French ministry of instruction to deliver a number of lectures on the French literature and language in various parts of Scotland and England.

A number of Herefordshire teachers came out on strike on January 31 owing to the refusal of the local education authority to establish a scale of salaries, whereby if a teacher's record is satisfactory his pay shall increase automatically until a maximum is reached. We learn from the London *Times* that the strikers include the head teachers of about 80 out of some 176 schools. In addition, there are schools where assistants and not the headmasters or mistresses are ceasing work. More resignations will fall due as the weeks pass, until at the end of March 117 head teachers out of 189 employed will be idle, and, including assistants, a total of 223. Before the teachers' threat to strike the average salary of headmasters was £111, against an average for all the British counties of £146 6s., and the average salary of head mistresses was £88 16s., against £100 8s. for the English counties. There were similar disproportions in the salaries of class teachers. The local education authority, admitting that the salaries paid in Herefordshire were low, increased the salaries of certain teachers in December last by amounts totalling £1,300 a year.

Dr. Ethelbert D. Warfield has resigned the presidency of Lafayette College.

Dr. George E. Brewer has been appointed to the chair of surgery at the College of Physicians and Surgeons of Columbia University. Dr. Walter B. James has asked to be relieved from membership in the medical faculty. He will retain his professorship and continue to direct research students from time to time.

J. F. McClendon, of Cornell Medical College, New York City, has accepted a position in the department of physiology, University of Minnesota Medical School.

Dr. Watson Marshall has been appointed demonstrator in laryngology in the School of Medicine of the University of Pittsburgh.

Dr. Marienne Plehn, assistant in the biological laboratory at Munich, has been made professor. She is said to be the fifth woman to receive this title in German universities.

Dr. August Brauer, director of the zoological museum of the University of Berlin, has been called to a professorship at Bonn, but it is expected that he will remain at Berlin.

Discussion and Correspondence

The Cytological Time of Mutation in Tobacco

In the issue of Science for January 2, 1914, there is described a mutation that occurred in a variety of the common tobacco which gives promise to become of great economic value. In the article referred to it was assumed that the germinal change must have occurred after fertilization because the aberrant plant bred true. Professor Castle has asked if parthenogenesis may not be as reasonable an interpretation of the phenomenon since parthenogenesis is known to occur in *Nicotiana tabacum*.

The possibility had naturally occurred to us. And since it is impossible to prove a negative the same alternative may be presented in discussing any Angiosperm variation. Mrs. Rose Haig Thomas has reported parthenogenesis in *Nicotiana* and her work has been confirmed by Bateson on *one* variety.

One may not deny their conclusions, but the theorem of logic used above holds here as well. While admitting the possibility that Mrs. Thomas has found strains of parthenogenetic *Nicotiana*, it is possible that her results were incorrectly interpreted. We have made numerous attempts to secure parthenogenetic seeds from various species of *Nicotiana* without success. Dr. E. M. East and Mr. R. Wellington made nearly one thousand such attempts with over 50 species and varieties of the genus, also without success. We think it reasonable to assume, therefore, that parthenogenesis in *our* strain of *Nicotiana* is extremely improbable.

H. K. Hayes,
E. G. Beinhart
Connecticut Experiment Station,
New Haven

Winter Coloration of Weasels

To the Editor of Science: It is well known that throughout Canada, and in the northern parts of the United States, the weasels become white in winter, whereas in the southern, warmer parts of the country they do not do

so, but remain brown. I am anxious to trace the southern boundary of the region in which these animals make this change—become white. I should be grateful, therefore, if any naturalist, trapper, or other reader of this journal, who believes he lives near this sought-for southern boundary, would send me word upon a post-card, or by letter, whether the weasels in his locality turn completely white, or only partly so, or whether some turn and others do not; and also whether the change appears to him to depend upon the coming of snow—that is does its time vary with the comparative earliness or lateness of a season?

ERNEST INGERSOLL

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SCIENTIFIC MEN AND PHONETIC SPELLING

TO THE EDITOR OF SCIENCE: Professor J. C. Arthur, of Purdue University, says in SCIENCE for October 10, 1913, p. 513:

> He is a brave man who openly throws stones at another man's domicile, even if he justify the act as altruistic, knowing the proverbial danger incurred.

Professor Arthur thereupon bravely throws stones at Dr. Dabney, and now I wish to throw a few friendly stones at Professor Arthur, at Dr. Dabney and at most of the other eminent contributors to SCIENCE. True,

> It is not the proper plan
> For any scientific gent to whale his fellow man.

But throwing stones is not "whaling," and all scientific gents will agree that a mere philologist can not be himself a scientific gent according to the statute in that case made and provided.

Professor Arthur chides Dr. Dabney for using the phrase "fungus growth," though he would excuse the phrase if it were intended for "fungous growth," "with the *o* accidentally omitted." But suppose Dr. Dabney, like some other scientific men, for example Dr. Wilder, should spell the adjective *fungous* with the *o* intentionally omitted? Would that be a violation of "good English" or of "good grammar"? Many scientific men would say so. Other scientific men would not say so.

The point that I make is that many contributors to SCIENCE, in criticizing matters of language and grammar, ignore a much more important matter in the relation of science to language. Even the gentlemen who write long and interesting articles about nomenclature, and insist with vehemence on the retention of this or that name or spelling or misprint, because it happened so (surely a free and easy attitude in science), do not touch upon the vital point. Most of them, by their example, or by abstaining from utterance or action, are preventing the scientific discussion, and the scientific settlement, of important matters of language relating to science. That is, they will not consider or discuss, or help others to consider or discuss, in print, the scientific notation of the English language, or of other languages. By their conservatism, obscurantism, ignorance, indifference, apathy, hostility, fury, cynicism, geniality, orthodoxy, call it what you will (and it is some or all of these), they prevent the editors and readers of the journals of science from dealing with this important matter of science.

They may write to their journals about the pronunciation of this or that word, sometimes about the etymology of this or that word, but, usually what they write, or at least what is printed, is superficial, insufficient or inexact; in a word, unscientific.

The reason is, I suppose, that most of the orthodox men of science do not know anything, accurately, about the pronunciation of English words, or about the sounds of English, or about the sounds of any language. They do not know, and will not try to find out, what symbols they should or might use in order to indicate with accuracy the sounds they wish to indicate or to discuss. And even those who do know these things, and can use, with a pen, an adequate notation of sounds, can not present that notation in the pages of a scientific journal, unless by a special arrangement with a more or less reluctant editor or group of editors, or at an expense which the writer himself must meet. In short, the orthodox scientific men of the United States and of Great Britain are, in this

matter, either unscientific, or are prevented, by some of their orthodox leaders from being scientific, in what should be an elementary matter of science, namely the accurate ascertainment and the intelligible record of the sounds of the English language, and of the other languages used in science. They are thus hostile to the sciences of philology and phonetics; and some openly proclaim their hostility.

If any of your correspondents who may do me the honor to dissent from these views will attempt to state in SCIENCE (and I am sure that the editor would be willing to permit the experiment) the actual facts about the words which Professor Arthur mentioned, namely, *fungus, fungous,* and *fungoid* (or any other group of words offering like conditions); to state exactly, in print, the pronunciation which those words have or should have; to state exactly what is or what should be the plural of *fungus;* to state exactly the nature of the difference between *funguses* and *fungusses;* to state exactly the different pronunciations of *fungi;* to state also whether the word so spelled is Latin or English, and whether it is Latin or English in all its pronunciations, or in one—if any one will try to do this, and succeed in doing it without recourse to the abhorred science of philology, and the despised "fad" of phonetics, I should like to see the result.

Even in the much simpler matter of a modernized spelling of English, we find the scientific journals holding aloof from the scientific view, and clinging to an unscientific and medieval spelling, while, nevertheless, in their columns we find frequent jibes or jabs at other medieval superstitions, and at other popular errors.

Yet nearly one fourth of the men who are recorded in Dr. Cattell's biographic dictionary, "American Men of Science," in the first edition, signed a card agreeing to use some simplified spellings, and thereby gave the idea the value of their approval. No doubt they still cherish the same sentiments. In fact, some of them cherish these sentiments so fondly that they are wholly unwilling to part with them, or to share them with the public. So they wrap themselves in their intellectual integrity, put over that the cloak of scientific orthodoxy, and go about disguised as harmless men. And the directors of scientific societies and institutions sit and do likewise. Then they arise and print pretty things about science and progress.

And longer should I sing, but with a frown the editor, impatient, rises. Having thus laid myself open to a lapidation of my meter (which some scientific gents *will* spell "metre," or die in the attempt), not to say of my orthographic orthodoxy, I blush and drop my sling—before I smile a sickly smile and curl up on the floor.

CHARLES P. G. SCOTT

SCIENTIFIC BOOKS

Gas Analysis. By L. M. DENNIS, Professor of Inorganic Chemistry in Cornell University. New York, The Macmillan Co., 1913. Pp. 434. Price $2.10 net.

This book may perhaps be described as the American Hempel. It is based upon the translation of Hempel's last edition, but extensive additions have been made by the author. The reviewer has always considered the plan of publishing researches in a text-book open to question, even though this adds materially to the value of the book to the investigator. It would seem better to make them much more widely known by having the researches appear in a periodical.

It is fair to expect in a work of its size that it should be encyclopedic and that the latest work should be included. No mention however is made of Uehling's automatic apparatus for analyzing chimney gas; of the Sargent gas calorimeter; of Elliott's gas apparatus, which is probably the most widely used of any for illuminating gas; of Hinman-Jenkins's method for total sulphur; of Crafts's method for purifying mercury; of the excellent work of Burrell and others of the Bureau of Mines in analyzing mine gases; of the detection of carbonic oxide by birds and mice; of the absorption of hydrogen by palladium chloride; of the practical application of chimney-gas analysis and of the calculations involved.

It is difficult to see in a work devoted exclusively to gas analysis why nearly a chapter should have been given to the heating value of solid fuel; or why the practically obsolete Honigmann gas burette should be described; or why the method of Drehschmidt-Hempel for total sulphur—which is almost never used in this country—is included.

One can not help being struck by the way in which reference has been avoided to American apparatus, and to a lesser degree to American work in this field. For example, Fig. 26 is of a German wet gas meter with the information that it can be obtained from Elster of Berlin! This extreme conservatism or love for German apparatus leads the author still to use the form of sulphuric acid pipette (p. 247) which is slow and may give rise to inaccurate results; to employ the expensive and clumsy double absorption pipette (p. 57) which is difficult to fill and empty; to fasten the gas pipettes with plaster of Paris (p. 54) into their fixed iron supports, instead of using screw clamp holders or a wax that can be melted and a movable collar which allows pipettes of almost any dimensions to be employed; and finally to say (p. 85) that the rubber protecting bulbs for the Orsat pipettes are a "drawback" or "rapidly deteriorate"—which those of German make certainly do; had he used those of good American manufacture he would have had no trouble. It was shown years ago how all these difficulties could be avoided and experience with hundreds of students has confirmed the methods then recommended.

In spite of these defects the book has many excellent features. Chapter XI., on the calculations involved in the combustion of gases, is especially good, as is also the treatment of ozone and carbonic oxide. The chapter on acetylene is very complete. Among new apparatus is mentioned the gas refractometer and rotameter, and also some gas absorption bottles; among new methods may be noticed the determination of hydrogen by colloidal palladium and of oxygen by sodium hyposulphite. The book is particularly valuable in research or to the experienced man.

A. H. GILL

Mechanism. By ROBERT MCARDLE KEOWN, B.S., Assistant Professor of Machine Design, University of Wisconsin.

Professor Keown has attempted in this book to give a brief treatment of the subject of mechanism in such a way as to furnish material for half a school year's work of six hours per week partly in the class room and partly in the drafting room. The book contains little that is new in the way of subject matter covered and there is much similarity to other and older text-books in the general method of handling certain parts of the subject. The order in which the various mechanisms are considered is radically different from that usually followed and impresses one at first as being rather questionable, although the author seems to have found it satisfactory in his own teaching.

Chapter I. gives the usual discussions and descriptions of motion, velocity, etc., most of which are well stated. The student is then plunged at once, in Chapters II. to V., into the consideration of link work with all its intricacies, so puzzling to the student whose imagination has not yet been trained sufficiently to enable him to readily grasp this rather difficult part of the work.

Chapter VI. presents a fairly thorough and clear treatment of the subject of cams and is particularly well illustrated with a large number of diagrams and pictorial drawings.

Chapters VII. and VIII. treat the subject of gearing both for parallel and non-parallel shafts. The treatment is clear, with considerable practical information and a number of good illustrations.

Very little attention is given to the important matter of trains of gears. A short chapter is devoted to connection by means of belts, chains, and ropes, and another short chapter to various mechanisms for giving intermittent motion. The book contains a large number of illustrations, many of which are exceptionally good. A number of problems are given at the end of each chapter, adapted both for class room work and for solution on the drawing board. These form a valuable part of the book.

W. H. JAMES

Elementary Machine Design. By William C. Marshall, Assistant Professor of Machine Design in Sheffield Scientific School of Yale University.

This book is prepared for the use of students who have not studied mechanics or mechanism. It is in reality a book of information and instructions for a course in drawing various machine details. The course as outlined would give a student familarity with many of the details of machine construction and considerable practise in drawing them. No attempt is made, however, to give training which would enable the student to look at a problem in machine design in a broad way and to attack it understandingly. It seems fair then to call it a book of information rather than a text-book either of machine design or machine drawing. It would be a valuable handbook for a draftsman who is already familiar with the principles and methods of machine design.

The first chapter consists of a discussion of machine drawing, general in some respects and minute in others. The other chapters treat of rivets and riveted joints, piping, screws and bolts, shafting and shaft couplings, stuffing boxes, bearings, journals, hangers, pistons and piston rods, connecting rods, pulleys, belting, gearing, valves. Under the head of "Useful Information" are a number of convenient tables, and similar tables are scattered through the book.

W. H. James

Grundriss der Kristallographie. By Dr. Gottlob Linck. Third Revised Edition. Jena, Verlag von Gustav Fischer. Pp. viii + 272. Figs. 631. Colored Plates, 3. Price 11.50 Marks.

The appearance of a third edition of this excellent text-book of crystallography only five years after the publication of the second edition is an indication that its author has succeeded in treating what is usually regarded as a dry subject in a way that has attracted many readers. A part of the popularity of the volume is due no doubt to the fact that crystallography is being studied abroad more and more thoroughly by chemists and physicists since the spread of interest in physical chemistry. Unfortunately, in America the science has few followers, but in Germany and England it appears to be enjoying a renaissance. Crystallography no longer deals merely with the description of crystal forms and the calculation of crystal constants. In its modern phase it is more directly concerned with the relations that exist between the forms and properties of substances and the proper explanation of these relations. Crystallography is rapidly becoming a branch of physical chemistry. It is because the author has realized this tendency in the science and has given us a book that deals so fully with the fundamental conceptions of physical and chemical crystallography that his volume has been received with such universal favor.

Of the new edition, 96 pages are devoted to the discussion of crystal forms and the balance to the discussion of the physical and chemical properties of crystals. There is no difference in method of treatment in the second and third editions. There are 27 more figures and 18 more pages in the new edition, but these additions are simply expansions of a few of the topics treated in the earlier edition. The additional figures were introduced mainly to emphasize some of the statements concerning the mechanical and optical properties of crystals, and the additional pages are the result of a little more detailed discussion of their optical properties. Throughout the book, where necessary, the text has been changed to bring it up to date and a few paragraphs have been introduced to call attention to some of the recent new work on crystals. The new figures are all of the same high grade of excellency as those characterizing the second edition.

The new edition is unquestionably the handsomest, best proportioned, most concise and at the same time most comprehensive elementary text-book on crystallography in any language. It is readable because logical, and it is modern. Moreover, it is not burdened by the involved sentences and the otherwise atrocious style that characterize so many German science text-books.

W. S. Bayley

SCIENTIFIC JOURNALS AND ARTICLES

THE opening (January) number of volume 15 of the *Transactions of the American Mathematical Society* contains the following papers:

T. H. Gronwall: "On the degree of convergence of Laplace's series."

L. E. Dickson: "Linear associative algebras and abelian equations."

W. B. Fite: "Some theorems concerning groups whose orders are powers of a prime."

R. E. Root: "Limits in terms of order, with examples of limiting element not approachable by a sequence."

O. E. Glenn: "The symbolical theory of finite expansions."

B. H. Camp: "Lebesgue integrals containing a parameter, with applications."

J. L. Coolidge: "Congruences and complexes of circles."

The Decmber number of the *Bulletin of the American Mathematical Society* contains: Report of the Madison Colloquium, by Arnold Dresden; Report of the Vienna meeting of the Deutsche Mathematiker-Vereinigung, by Virgil Snyder; "On binary modular groups and their invariants," by L. E. Dickson; "On some systems of collineation groups," by H. H. Mitchell; "On the sumability of Fourier's series," by T. H. Gronwall; "Note on Pierpont's Theory of Functions," by G. A. Bliss; Review of Reid's Theory of Algebraic Numbers, by E. B. Skinner; Review of the Festschrift Heinrich Martin Weber zu seinem siebzigsten Geburtstag, by R. C. Archibald; "Shorter Notices": Murray's Plane Trigonometry and Tanner and Allen's Analytic Geometry, by C. B. Hennel; Müller's Gedenktagebuch für Mathematiker and Ebner's Technische Infinitesimalrechnung, by E. W. Ponzer; Webster's Dynamics of Particles and of Rigid, Elastic and Fluid Bodies, by W. R. Longley; "Notes"; and "New Publications."

THE January number of the *Bulletin* contains: Report of the October meeting of the society, by F. N. Cole; Report of the twenty-fourth regular meeting of the San Francisco Section, by Thomas Buck; Report of the seventh regular meeting of the Southwestern Section, by O. D. Kellogg; "The infinite regions of various geometries," by Maxime Bôcher; "Shorter Notices"; Auerbach and Rothe's Taschenbuch für Mathematiker und Physiker, by G. A. Miller; Sommer-Levy's Théorie des Nombres algébriques, by E. B. Skinner; Carslaw's Infinitesimal Calculus, by A. M. Kenyon; Young's Monographs of Modern Mathematics, by R. D. Carmichael; Hawkes's Higher Algebra, by J. E. Rowe; Evans's Teaching of High School Mathematics, by E. B. Lytle; Fischer's Koordinatensysteme, by E. J. Wilczynski; "Notes"; and "New Publications."

THE February number of the *Bulletin* contains: "Some theorems on the convergence of series," by R. D. Carmichael; "A translation principle connecting the invariant theory of line congruences with that of plane n-lines," by O. E. Glenn; "Some mathematical booklet series," by R. C. Archibald; "Mathematical models," by R. C. Archibald; Review of Darboux's Systèmes orthogonaux et Coordonnées curvilignes, by E. J. Wilczynski; Review of Church and Bartlett's Descriptive Geometry, Low's Practical Geometry and Graphics, Hauck's Darstellende Geometrie, and Müller's Darstellende Geometrie für technische Hochschulen, by Virgil Snyder; "Shorter Notices"; Hensel's Zahlentheorie, by L. E. Dickson; Volterra's Equations intégrales et Equations intégro-différentielles, by Jacob Westlund; Kowalewski's Komplexe Veränderlichen und ihre Funktionen, by Arnold Dresden; Bachelier's Calcul des Probabilités, by H. L. Rietz; Einstein and Grossmann's Verallgemeinerte Relativitätstheorie, by E. B. Wilson; "Notes"; and "New Publications."

THE BOTANICAL SOCIETY OF AMERICA

II

The Anatomy of the Node as an Aid in the Classification of the Angiosperms: E. W. SINNOTT.

The node of vascular Cryptogams and Gymnosperms is recognized as a conservative region. Investigation shows that the nodal structure of Angiosperms, as well, is slow to change and is

therefore of value in classification. In the Coniferæ the foliar supply leaves only a single gap in the cylinder, but in the lower Angiosperms the several traces which supply every leaf come off from the stele some distance apart and each causes a gap of its own. The primitive number of foliar traces and corresponding gaps among Angiosperms seems to have been three. This is characteristic of the Amentiferæ, the simpler Ranales, the Urticales and the Rosales. It also persists in some of the higher orders, such as the Caprifoliaceæ and Compositæ. In other groups, this condition has been amplified into one with a large number of strands and gaps, as in the Magnoliaceæ, the Polygonales, the Araliales and the Monocotyledons. In still others the three gaps have become approximated and merged into one, as in the Centrospermæ, Myrtales, Ericales, Ebenales and Tubifloræ. The great simplicity of these nodal characters and their uniformity throughout such large groups of plants make them of much value in determining broad lines of relationship.

Primitive Characters Recalled by the Chestnut-bark Disease and Other Stimuli: I. W. Bailey and J. S. Ames.

Dicotyledonous leaves with entire margins predominate in tropical regions, but are comparatively infrequent in boreal and mountainous regions. Subtropical and tropical representatives of boreal families have commonly entire leaves. Deeply lobed, dentate or serrate leaves are characteristic of Fagales endemic in northern latitudes. Toward the tropics the margins of the leaves become progressively entire. It seems probable that all living representatives, at least, of the Fagales, are descendants of boreal or mountainous forms, since vestiges of lobes, dentations and serrations persist upon young vigorous plants of subtropical species. Furthermore, the boreal type of foliage is recalled in mature parts of these plants by the stimulating effects of very rapid vigorous growth and the irritating effects produced by the attacks of insects and fungi. A striking illustration of these phenomena is afforded by the common American chestnut, *Castanea dentata* Borkh. Foliage formed subsequent to severe infections of the chestnut-bark disease (*Endothia parasitica* Murrill) is typically oak-like, frequently resembling closely *Quercus rubra* L. The reversion is not confined, however, to external characters. For the wood formed by the diseased cambium possesses anatomical structures which are a characteristic feature of the genus *Quercus*.

The Archegonium of Sphagnum subsecundum: George S. Bryan.

Sphagnum subsecundum, where studied in the region near Chicago for the past two autumns, has been found to bear enormous numbers of sex organs. The archegonial and antheridial heads are not difficult to recognize, and may be easily distinguished from each other.

A careful study brings out the following facts, as a general statement, in regard to the development of the archegonium. Archegonia are found to occur terminally on short side branches which rise near the apex of the main stem. The apical cell of one of these branches becomes an archegonial primordium in which oblique walls appear. The cell above these walls produces the primary archegonium; while each lateral segment cut off by them forms a secondary archegonium. In the archegonium initial the first wall is transverse, and usually subsequent transverse apical divisions give rise to a filament of cells varying in number from four to six. In each cell of the filament secondary divisions occur. Finally the apical cell of the filament enlarges and oblique walls, followed by a transverse wall, cut out a cover cell and a central cell. The cover cell forms chiefly the cap of the archegonium, while the central cell on division produces a primary canal cell and a ventral cell. The primary neck canal cell gives rise to a veritable number of neck canal cells, frequently from six to eight. The ventral cell divides very late, forming the ventral canal cell and the egg. Usually just after this latter division the neck canal cells break down, but the ventral canal cell is persistent, rounding off and coming to lie in the venter near the egg, from which it may be distinguished by its slightly smaller size. Shortly before fertilization the ventral canal cell goes to pieces.

So-called abnormalities occur. Two eggs and two ventral canal cells occur occasionally, while in one case a large venter was found in which were ten such cells.

On the Structure and Relationships of Macroglossum: D. H. Campbell.

Macroglossum Copeland is a genus of Marattiaceæ, founded upon a species, *M. Alidæ,* sent from Sarawak in Borneo. The writer collected it at two stations in February, 1913, and secured material of both sporophyte and gametophyte. Another species was found growing in the botanical gardens of Buitenzorg, under the name *Angiopteris Smithii* Raciborski. The origin of this lat-

ter plant is unknown, but it was probably brought from Borneo.

Macroglossum differs from *Angiopteris* in several important respects. It has simply pinnate leaves, much more like *Danæa* than *Angiopteris*. The sporangia, while distinct, are quite different from those of *Angiopteris*, and closely resemble those of *Archangiopteris* The number of sporangia in the sorus is much greater than in *Angiopteris*, sometimes exceeding 60. The indusium is also much better developed than in *Angiopteris*. There are also some important anatomical differences in the leaf structure.

Macroglossum is a large fern, the leaves being about four meters in length. In habit it resembles a gigantic *Danæa*—and also suggests strongly some of the larger species of *Zamia*. The leaflets reach a length of over 50 centimeters.

The prothallia are very large, sometimes nearly three centimeters in length by two in breadth. They are monœcious. The antheridia are very large, but otherwise much resemble those of *Angiopteris*, as do the archegonia. The embryo has a conspicuous suspensor.

Macroglossum undoubtedly belongs to the Angiopterideæ, but its affinities are rather with *Archangiopteris* than with *Angiopteris*. Like *Archangiopteris* it suggests a distant relationship to *Danæa*.

Morphology of Thismia (Bagnisia) americana n. sp.: NORMA E. PFEIFFER.

Among the Burmanniaceæ the forms closely related to *Thismia americana* have been found up to date only in the southern hemisphere, mostly in the Malay Archipelago. The particular subdivision to which this *Thismia* shows affinities has been for the most part discovered in recent years. The finding of one in a region so remote from the home of its relatives as Chicago, augurs well for the possibility of other undiscovered forms. The reduced size and anatomy of this saprophytic form are noteworthy. The floral axis arises simultaneously with a secondary root from the main root. The structure of the flower is similar to that of other *Thismias* of the *Bagnisia* section. Floral development is somewhat similar to that in the Orchidaceæ, to which resemblance in other features is evident. The characters are deemed sufficiently distinctive to warrant the establishment of a new species.

Some Observations on the Anatomy and Other Features of the Black Knot: ALBAN STEWART.

Enlargements, popularly known as "black knots," are formed on the branches of *Prunus virginiana* L. and other species of cherries, by the attack of the fungus *Plowrightia morbosa* (Schw.) Sacc. These knots may arise primarily through the infection of the branch by means of spores, or, secondarily, by the spreading of the fungus through the tissues from a knot already formed.

Normal wood of *P. virginiana* usually contains rays from one to four cells wide in cross section. As a result of the stimulating action of the fungus these rays may become much broader in infected tissue, simulating the structure of compound rays. The production of the usual elements of the xylem is greatly inhibited during the first season's growth of the knot, but there is a correspondingly great production of xylem parenchyma, which is almost absent from normal wood. By further increase in size of parenchyma cells the knot is greatly enlarged during the second season of its development. The cambium is pushed outward by this means, and with it are isolated groups of fibers and other xylem cells. There is also an abnormal growth of the ray tissue at about this time, which ruptures the cambium, opposite the rays, and pushes segments of it outward into the bark. By further division of these misplaced cambium cells, various xylem elements are produced in the bark very much out of their normal position. The segments of the cambium, which remain between the rays, retain their relative position throughout the subsequent development of the knot, and give rise to wedges of xylem each of which is subtended by a mass of phloem on the outside.

There is apparently no abnormal growth in the outer portion of the bark. It is sloughed off just before the conidia are produced.

Homologies of the Frond in Lemna: FREDERICK H. BLODGETT.

The plant body in *Lemna* has been considered by various authors as a leaf, a stem or a combination of these, but in most cases little morphological evidence is advanced for one or the other idea. The structure of the frond, especially during its early stages, is used as the basis of a discussion of the parts present. It is concluded that the frond represents a single leaf at the tip of a stem of one internode, at the tip of which a dichasial stem apex is located, and ventrally an adventitious root developed. The dichasial buds are protected by the sheath or pouch of the frond, which develops simultaneously with the buds, from the tissue immediately about the insertion of the buds upon the apical tissues, becoming congenitally

fused with the basal margin of the leaf and the lateral margin of the stem (stipe) just where this unites with the leaf.

The vertical restriction upon axial growth is found to limit the development of new parts to the horizontal plane, and successive outgrowths are produced as lateral developments rather than in a vertical succession as in normal erect stems. No new parts are found, but those present have undergone reduction as a result of adaptation to the floating habit.

Development of the Embryo and the Germination in Lemna perpusilla: Frederick H. Blodgett.

The embryo of *Lemna* develops directly from the egg cell, all of which is involved in the formation of the embryonic tissues, a true suspensor not being differentiated. The plumule becomes folded against the hypocotyl so that its tip is just under the micropyle. In this position it is enclosed by the overgrowth from the base of the cotyledon, forming a sheath or pouch. At the base of the plumule a bud is developed, which is the first true frond, and this bears the first pair of buds characteristic of the dichasial branching of the plant. The anterior half of the embryo is the cotyledon, and acts as an haustorial organ during germination, and does not function otherwise. The plumule emerges from the sheath from a horizontal slit, thus lying from the first in the plane of the water surface. The germination of the seed is in general of the type of *Pistia*, differences being due to the greater degree of reduction in the case of *Lemna*, rather than inherent variations in method.

The Chemical Dynamics of Living Protoplasm: W. J. V. Osterhout.

Van't Hoff's formulation of the laws of chemical dynamics has proved so stimulating to various fields of chemistry that it may be expected to be similarly useful if it can be applied to the activities of living protoplasm. The writer finds that by measuring the electrical resistance of living tissues it is possible to follow the progress of reactions in protoplasm in the same way that van't Hoff followed the progress of reactions *in vitro*. It therefore becomes possible to apply van't Hoff's methods and formulæ directly to protoplasm in its living and active condition. The following example will suffice to show how this may be accomplished.

The electrical resistance of living tissue of *Laminaria* was measured by a method which has been previously described. The tissue had in sea-water a resistance of 980 ohms. On being placed in NaCl .52M (which had the same conductivity as sea-water) the resistance fell after 10 minutes to 865 ohms and after 20 minutes to 745 ohms: it continued to fall rapidly and finally became stationary at 320 ohms. This represents the death-point. The total change produced by the NaCl was $930 - 320 = 660$ ohms. In order to find out whether this change had been produced in such a way as to correspond to a known type of chemical reaction the amount of change was measured at brief intervals.

According to van't Hoff we can determine from such measurements whether one, two or more substances are taking part in the reaction. If only one substance takes part (or if two substances take part but only one of them changes its concentration noticeably) the reaction is said to be of the first order (monomolecular) and it proceeds according to the formula

$$k = \frac{1}{t} \log. \frac{a}{a - x},$$

in which t is the time which has elapsed between the beginning of the reaction and the taking of the measurement, x is the loss in resistance at the time t, a is the total amount of change in resistance when the reaction is completed and k is a constant (called the velocity constant) which indicates the speed of the reaction. If the reaction is of the first order (monomolecular) k should come out constant provided the temperature be kept constant during the reaction.

In this case a, which represents the total amount of change, is $980 - 320 = 660$ ohms, while x represents the loss of resistance after 10, 20, 30 minutes, etc. The calculations show that k is nearly constant: the variations are no greater than are commonly found in measuring chemical reactions in the test-tube.

Since the effect of NaCl is within wide limits completely reversible, without production of injury, *the conception of chemical dynamics here developed applies not only to reactions which produce death, but also to reactions which involve no injury* and which form a normal part of the activity of the cell. This conclusion is fully confirmed by experiments with a variety of other substances.

A Contribution to the Theory of Antagonism: W. J. V. Osterhout.

By means of electrical measurements of living tissues it is possible to predict which salts will antagonize each other when allowed to act upon these tissues.

Differential Permeability: W. J. V. OSTERHOUT.

Various kinds of surfaces in the cell, such as the outer "plasma membrane," the vacuole-wall, the nuclear wall, the surface of the chromatophore and the cell wall can be proved to differ greatly in their behavior with respect to permeability.

The term differential permeability may be suggested as an appropriate designation of these phenomena.

The Effect of Antagonistic or Balanced Solutions Containing Sodium Chloride together with One of the Chlorides of Calcium, Magnesium, Potassium, Strontium, Ammonium or Copper, upon the Growth of Corn Plants Rooted in an Artificial Soil: JOSEPH S. CALDWELL.

The primary purpose of the work was to determine in how far the use of a solid medium having known physical properties may modify the antagonistic relationships borne by sodium to each of the other ions named.

For each of the six pairs of salts, cultures were grown in finely divided quartz to which the salt mixtures were added, the optimum water content for the quartz being maintained constantly throughout the experiment. For each pair of salts, ten to twenty different concentrations were used, the lowest of such concentration as to totally inhibit development, the last so dilute as to be entirely without effect upon the plants. For each of these concentrations, a series of cultures consisting of twelve to sixteen mixtures of the two salts in proportions ranging from 60:1 to 1:60 was made, with check cultures in each of the pure salts. The complete series for any pair of salts, therefore, shows for each salt the range of inhibitory, toxic and stimulatory effects, for comparison with the effects of isosmotic mixtures in varying proportions with the opposing salt. In all cases, results are measured by comparison of the dry weights of roots and tops, taken separately, for cultures allowed to grow under controlled conditions for 30 days.

Antagonism between sodium and strontium manifests itself at all molecular ratios between Sr 1: Na 10 and Sr 1: Na 20, and in all concentrations between those just permitting measurable development and those too dilute to have discoverable effect, but manifests itself only through its effect upon root development.

The effect of additions of calcium to sodium is merely to decrease the characteristic physiological and morphological effects of sodium in a degree directly proportional to the amount added, but in no case can these characteristic effects be made entirely to disappear. The effect of calcium is a dilution effect and not an antagonistic one.

In mixtures of copper and sodium, sodium serves merely to dilute the copper salt, decreasing the toxic or the stimulatory effect in direct proportion to the amount added, but in no case annulling the effects of the copper ion.

Additions of magnesium to sodium in any proportions or at any concentration is without effect upon the development of aerial parts. In highly toxic concentrations, mixtures in the ratio of Mg 2: Na 1 give somewhat better development of roots, while in all stimulatory concentrations the ratio 1:1 gives greatest dry weight for roots. Mixtures of sodium and potassium inhibit development of both roots and tops, in all inhibitory or toxic concentrations, to a markedly greater extent than do isosmotic solutions of the pure salts. In stimulatory concentrations, the pure salts permit greater and more normal development than do mixtures. Sodium in any proportion, even in concentrations at which it is markedly stimulatory, decreases the stimulatory effect of potassium.

For mixtures of sodium with ammonium, highly toxic concentrations permit slightly greater development when the two ions are present in the ratio 1:1. For all stimulatory concentrations, the stimulatory effect is decreased in mixtures, growth becoming better as the ratio of one ion to the other increases from 3:1 to 60:1.

Metabolic Changes in Potato Tubers During Sprouting: CHAS. O. APPLEMAN.

The following metabolic changes occurred during the early stages of sprouting: (1) Under constant storage temperature the starch was depleted, while the reducing sugars showed a slight increase. The above carbohydrate changes were more rapid in the stem end. (2) Both diastase and invertase activity of the glycerine extract quickly doubled; the increase was greater in both cases in the extract from the stem half. (3) Catalase showed a marked increase which was slightly greater in the juice from the seed end where it was more active before sprouting. (4) The nitrogen of monamino-acids and their amide derivatives increased, while the nitrogen of diamino-acids and other organic bases and the water-insoluble protein nitrogen decreased. The abundant water-soluble protein nitrogen in the tubers showed a very slight increase. (5) Organic extractive and lipoid phosphorus increase at the expense of protein and inorganic phosphorus.

The increase in lipoid phosphorus began earlier in the seed end and increased more rapidly in this end. The decrease in the inorganic phosphorus at the same stage of sprouting occurred in the seed end only. It is interesting to note that in many cases the metabolic activity was greater in the stem half, although the sprouts were all borne on the seed end.

Biochemical Study of After-ripening in the Potato Tuber: Chas. O. Appleman.

Under normal conditions potato tubers will not sprout for several weeks after harvest. During this rest period certain changes occur in the chemical or physical situation of the buds or their immediate environment, which are essential to the release of the growth processes. These changes will be spoken of as after-ripening, using the term in its broadest sense.

The tubers used in this investigation produce sprouts much earlier from the buds on the seed end. The tubers were therefore cut in half and the analyses made separately on the seed and stem halves with the view to better detect the chemical changes characteristic of after-ripening.

The carbohydrate transformations during the rest period are dependent entirely upon changing temperature. Active diastase is present at all stages of the rest period and shows no increase during natural after-ripening. Protein, lipoid, organic extractive and inorganic phosphorus, calculated to per cent. of total phosphorus, each remain constant up to the time of sprouting. After-ripening does not involve proteolysis or other changes in the various nitrogen combinations.

Metabolic changes involving the above substances and some others studied, begin rather suddenly and are concurrent with sprouting. They are, therefore, not primary processes of after-ripening.

The Physiology of the Rest Period in Potato Tubers: Chas. O. Appleman.

The rest period of the potato tuber is not firmly fixed and hereditary, as it can be entirely eliminated by means which will effect a proper adjustment between the bud tissue and external agents.

The Nutritive Value of Glycocoll to Plants from Peat Soils: A. Dachnowski and R. Gormley.

In this preliminary statement data are submitted which were obtained from experiments in the laboratory with a variety of wheat and with several bog plants, among them *Oxycoccus, Scheuchzeria* and *Juncus*. Aside from the nutritive inequalities of amino compounds, the attempt is made to determine the limiting concentrations of organic and inorganic acids and how far fungal micorrhiza are of importance in any special absorptive powers of plants.

Twining of Plants as Related to Withdrawal of Light: F. C. Newcombe.

Various plants when deprived of light lose, in the course of a few days, their power of circumnutation, and pursue a straight course, either orthotropic or plagiotropic. This loss of circumnutation is not a starvation phenomenon, but is due to a change in geotropic sensitiveness. When the plant is restored to the light, it regains, after several days, its twining ability.

Influence of Light on Infection of Certain Hosts by Powdery Mildews: George M. Reed.

An attempt has been made to study the influence of various factors as water supply, temperature, mineral starvation, light, etc., upon infection of hosts by powdery mildews. The results here reported relate to the influence of light.

Seedlings of barley and wheat have been grown in the dark until the first leaf was about 2 to 3 centimeters long. The plants were then inoculated with the mildew from their respective hosts. Some of the plants inoculated were kept continuously in the dark; others were removed at once and placed in the light; at intervals of 24 hours other inoculated plants were taken from the dark and placed in the light. The general results were that no infection occurred if the plants were kept in the dark after inoculation. Upon their removal to the light, infection occurred in proportion to the degree to which the etiolated leaves turned green. In general the period of incubation was retarded proportionally to the time the plants were kept in the dark.

Another series of experiments was carried out, first growing the plants in the light and then, after inoculation, placing them in the dark, some immediately, others at intervals of 24 hours. In the case of the plants placed at once in the dark no infection occurred. Those, however, that were kept in the light for one or two days became infected. The period of the incubation of the fungus, however, was materially retarded. In general the effect of the absence of the light upon the mildew is considered to be an indirect one and has to do with the primary effect upon the development of chlorophyll in the host cell. The infection fails to occur in those cells which have not developed the chlorophyll. The mildew then is a strict parasite attacking cells which are not capable of carrying on their normal functions.

These results are quite different from those obtained by inoculating etiolated plants with saprophytic fungi. Under such conditions, in some cases at least, saprophytic fungi are able to develop on the living tissues.

Resistance of Certain Fern Prothallia to Extreme Desiccation: D. M. MOTTIER.

The prothallia of *Camptosorus rhizophyllus* and of other forms found on dry hillsides and on limestone cliffs have been subjected to conditions approximating prolonged drought in the natural environment and to conditions of extreme desiccation in the laboratory. The part the prothallia play in the ecological adaptation of these ferns is shown by their survival of the most extreme laboratory conditions and by their subsequent production of sporophytes. For example, prothallia of *Camptosorus* survive exposure to glycerine-dried air for a period of six weeks, and those of other genera even a more extended desiccation under similar and different conditions. A continuation of work published in the November number of the *Bull. Torr. Bot. Club.*

The Pyrenoid of Anthoceros: F. MCALLISTER.

All of the cells of the gametophyte of *Anthoceros lævis* contain a single large chloroplast, each of which has near its center a pyrenoid. The pyrenoid is not a homogeneous, kernel-like structure, as is the case in the algæ, but is a multiple structure made up of a dense group of from 25 to 300 disc- or spindle-shaped bodies. These bodies are protein according to the standard microchemical tests. During photosynthesis the outer bodies are transformed directly into rudimentary starch grains while new bodies seem to be formed in the interior of the mass by fission. The rudimentary starch grains increase in size as they are pushed toward the periphery of the chloroplast by younger starch grains.

In the embryonic tissue of the sporophyte the pyrenoid can not be identified, but as these cells are pushed upward scattered bodies seem to aggregate in the center of the chloroplast to form it. When fully formed it differs in no way from the pyrenoid of the gametophyte. In the sporogenous layer, however, no pyrenoids are visible and the abundant starch grains of the spore mother-cells and the spores seem to be formed much the same as in other Bryophytes.

Physical Factors in the Cleavage of Cœnocytes: R. A. HARPER.

In the Myxomycete *Didymium* we have the spores formed by progressive cleavage essentially as in *Fuligo* and the sporanges of the Mucorineæ. The presence of a capillitium of radial fibers, however, apparently makes possible the manifestation of certain factors in the process of division which are not so easily recognizable in other cases. The first visible step in cleavage seems to consist in the extrusion of water from the protoplasm. This water collects to form from one to several vacuole-like bubbles on the capillitial threads. Further contraction and extrusion of water goes on till each capillitial thread comes to be enclosed by a watery sheath. Progressive cleavage by furrows now sets in from the surface of the spore sack and from the surface of these water sheaths around the capillitial threads. Ultimately we have uninucleate spores. The whole process seems to involve active extrusion of water, and if we conceive that the chemical constitution of the nuclei is such as to favor the retention of moisture in the cytoplasm immediately adjacent to them we should have a condition which would tend toward the orientation of the cleavage furrows in such a position as to lead ultimately to the production of uninucleated spore masses.

The Harmful Action of Distilled Water: R. H. TRUE.

It appears probable that the problem of injury by distilled water is not a simple one capable in all cases of a like explanation. In some cases, distilled water obtained from apparatus having copper surfaces exposed to contact with the water undoubtedly derives certain toxic properties from minute traces of copper. In other cases, doubtless, it is possible for other harmful impurities to find their way into the product, but after the action of all the impurities has been accounted for there still remains a residuum of harmful action due to no known type of impurity. This mode of harmful action seems to be most marked in water which shows the highest resistance to the passage of the electric current.

Samples of distilled water which show the highest resistance are in general more harmful to lupine roots than waters containing a large quantity of electrolytes. These same samples of water withdraw electrolytes from the tissues of the roots when they remain in the water. This leaching of electrolytes is shown to be the probable mechanism by means of which purer samples of distilled water exert their harmful action on the roots. This action has a physical osmotic component, but for the roots of *Lupinus albus*, this osmotic factor seems to be decidedly secondary

in importance, the primary cause of injury being the extraction of electrolytes and perhaps of other substances as well. This extraction by distilled water is regarded as but a special case of the general type of injury wrought on cells by unbalanced solutions whereby certain necessary constituents, undoubtedly in part inorganic, are dissociated from their proper attachments in the complicated chemical and physical mechanism of the living cell. The distilled water seems to withdraw material required for the maintenance of the efficient action of the protoplasmic limiting membranes, with the result that the permeability of the cells is increased, and a further dissociation of electrolytes from their points of combination in the proteids, and other chemical structures of the cell, ensues. These dissociated electrolytes escape from the cell and increase the conductivity of the distilled water. When a trace of calcium ions is present in the distilled water, this dissociating power of the distilled water over the proteids and other chemical mechanisms of the cells is largely developed, and the chemical integrity of the cells is protected in some way not known.

This report is preliminary in its nature and is to be followed at a future date by a further contribution reporting the results of work now under way.

Distilled Water in the Laboratory: R. H. True.

With the discovery made by Nägeli and Loew that copper distilling apparatus may yield water containing traces of copper sufficient to render the water harmful for plant cultures, the use of glass distilling apparatus became general, and carefully distilled water obtained from glass came to receive the general confidence of biologists. While in the majority of cases this confidence is well placed, errors in the interpretation of results are likely to follow a failure to recognize and allow for certain chemical and physiological characteristics of so-called pure water. Aside from the difficulty of obtaining pure water, this substance having been prepared in a pure state but a few times and then by chemists and physicists, there is the further difficulty of maintaining it in a pure state, since it readily becomes charged with gaseous products of the air, and when exposed to the air of the laboratory is especially likely to assume harmful properties for plant cultures—a danger which may be minimized through taking precaution to exclude these impurities from contact with the water. Another source of almost unavoidable contamination is seen in the solubility of the usual glass containers, which, unless specially prepared for the purpose, give up to the water sufficient solids to steadily increase the electrical conductivity.

Since a minimum of impurities will be found even in the purest water obtainable for practical experimental purposes, the action of the dilute solution which goes under the name of distilled water comes up for consideration. It has been shown that "distilled water" is injurious to the roots of certain plants, and that this action is paralleled by, and probably due, in great measure, to, the leaching of constituents necessary to the maintenance of life activities.

When check cultures grown in distilled water are used as a standard of comparison and regarded as normal, great danger of serious error in interpreting the results of biological experiments arises, since the behavior of check cultures in distilled water can not safely be regarded as an expression of normal activity.

It appears that plant physiologists need in their work a normal physiological solution, this normal solution to be such a medium as will cause the least possible disturbance to the usual activities of the plant. While the difficulties introduced by the use of a normal physiological solution are many, and will necessitate great care not only in meeting different requirements of various types of plants, but also with respect to the purity of chemicals used, the insolubility of glassware, the quality of distilled water employed, etc., there seems to be little doubt that such physiologically approximate mixtures are likely to give results much more closely approaching physiological soundness than is possible with the use of distilled water.

George T. Moore
Secretary

JOINT ANNUAL MEETING OF AMERICAN ANTHROPOLOGICAL ASSOCIATION AND AMERICAN FOLK-LORE SOCIETY

The annual meeting of the American Anthropological Association was held in West Assembly Hall, American Museum of Natural History, New York City, December 29–31, 1913, in affiliation with the American Folk-Lore Society. The joint program was unusually long and more cosmopolitan than at any previous meeting, and the sessions were well attended. The thanks of the members of both societies are due to the American Museum

of Natural History for the ample and attractive facilities provided; to the Explorers' Club for the welcome extended to members of the Council, and to Mr. George G. Heye and Professor Saville for a private view of the Heye Museum.

At the Cleveland meeting the secretary was instructed to prepare a list of names of persons eminent in anthropology to be submitted with the view of election to honorary membership at the New York meeting of the association. Pursuant to his instructions the secretary submitted a list which was referred to a committee named by President Dixon: Boas (chairman), Hrdlička, Peabody and the secretary, with instructions to recommend five names. The report of this committee was approved and the following honorary members were elected by the council: Professor Léonce Manouvrier, Paris, France; Professor Karl von den Steinen, Berlin, Germany; Dr. Alfred P. Maudstay, London, England; His Excellency W. Radloff, Saint Petersburg, Russia; Professor Emile Cartailhac, Toulouse, France.

Dr. Goldenweiser reported for the committee appointed to consider the advisability of devoting one number of the journals (*American Anthropologist* and *Journal of American Folk-Lore*) to recent progress in the field of American anthropology in connection with the International Congress of Americanists to be held in Washington, D. C., October 5–10, 1914. The report was accepted and Dr. Goldenweiser was instructed to complete his correspondence with contributors and to send the contributions to the editors for publication. The editor of the *Anthropologist* was instructed to have extra copies of the number in question printed for free distribution among foreign members of the International Congress of Americanists. The contributions already promised are: "Archeology," W. H. Holmes; "Physical Anthropology," A. Hrdlička; "Material Culture," Clark Wissler; "Mythology," Franz Boas; "Linguistics," P. E. Goddard; "Ceremonial Organization," R. H. Lowie; "Religion," Paul Radin; "Social and Political Organizations," A. A. Goldenweiser; "Historical Relations," J. R. Swanton and R. B. Dixon.

Dr. Hrdlička gave a detailed report of the progress made by the local committee in preparation for the forthcoming International Congress of Americanists to be held in Washington, D. C. The American Anthropological Association accepted an invitation to become a member of the congress, to which President Dixon named Franz Boas, of Columbia University, and George Grant MacCurdy, of Yale University, as delegates from the association.

A letter was read from Professor A. L. Kroeber, who expressed the hope that the association would accept the invitation of Mr. James A. Barr, manager of the Bureau of Conventions and Societies of the Panama-Pacific International Exposition, to hold a special session in San Francisco during the exposition. Professor Kroeber announced his readiness to do everything in his power to help make such a meeting a success. The invitation was referred to the executive committee with power to act.

The selection of a place for the next annual meeting of the association was likewise left to the executive committee, which has decided that the meeting shall be held in Philadelphia during the Christmas holidays, in affiliation with Section H of the American Association for the Advancement of Science.

The chair appointed a committee on nominations consisting of Boas, Lowie, Swanton, Gordon and MacCurdy, whose report was accepted by the association, the election of officers resulting as follows:

President—Roland B. Dixon, Harvard University.

Vice-president 1914—George A. Dorsey, Field Museum of Natural History.

Vice-president 1915—Alexander F. Chamberlain, Clark University.

Vice-president 1916—A. L. Kroeber, University of California.

Vice-president 1917—George B. Gordon, University of Pennsylvania.

Secretary—George Grant MacCurdy, Yale University.

Treasurer—B. T. B. Hyde, New York.

Editor—F. W. Hodge, Bureau of American Ethnology.

Associate Editors—John R. Swanton, Robert H. Lowie, and Alexander F. Chamberlain.

The following is a list of the addresses and papers presented:

"The Piltdown Skull," by Charles H. Hawes.

"Ten Days with Dr. Henri Martin at La Quina (Charente), France," by Charles Peabody.

"Paleolithic Art as represented in the American Museum of Natural History, New York," by George Grant MacCurdy.

"The So-called 'Argillites' of the Delaware Valley," by N. H. Winchell.

"Results of an Archeological Survey of the State of New Jersey," by Leslie Spier.

"The So-called Red Paint People Cemeteries of Maine," by Warren K. Moorehead.

"Stone Implements of Surgery (?) from San Miguel Island, California," by H. Newell Wardle.

"Etruscan Influence in West Africa and Borneo," by Earnest Albert Hooton. (By title.)

"Brief Account of Recent Anthropological Explorations under the Auspices of the Smithsonian Institution and Panama-California Exposition," by Ales Hrdlička.

"Results of Excavations at Machu Picchu," by Hiram Bingham.

"The Human Monster-figure on the Nazca Pottery," by Edward K. Putnam.

"Note on the Archeology of Chiriqui," by George Grant MacCurdy.

"The Maya Zodiac at Acanceh," by Stansbury Hagar.

"Chinese Antiquities in the Field Museum," by Berthold Laufer.

"Some Aspects of North American Archeology," presidential address, by Roland B. Dixon, followed by a symposium: "The Relation of Archeology to Ethnology," by Franz Boas, W. H. Holmes, Berthold Laufer, George Grant MacCurdy.

"The Horse and the Plains Culture," by Clark Wissler.

(*a*) "Wayside Shrines in Northwestern California"; (*b*) "Is there Evidence, other than Linguistic, of Relationship between the Northern and Southern Athapascans?" by P. E. Goddard.

"Phratries, Clans, Moieties," by Robert H. Lowie.

"The Social, Political and Religious Organization of the Tewa," by H. J. Spinden.

"Tewa Kinship Terms from the Village of Hano, Arizona," by Barbara Freire-Marreco. (By title.)

"The Cultural Position of the Plains Ojibway," by Alanson Skinner.

"Results of Some Recent Investigations Regarding the Southeastern Tribes of the United States," by John R. Swanton.

(*a*) "Notes on Alonquian Grammar"; (*b*) "Notes on the Social Organization of the Fox Indians," by Truman Michelson.

"My Experiences in the South Seas," by A. B. Lewis. (By title.)

"Field Work Among the Pagan Tribes of the Philippines," by Fay Cooper Cole.

"The Sac-sac or Human Sacrifice of the Bagobo?" by Elizabeth H. Metcalf.

"The Boomerang in Ancient Babylonia," by James B. Nies.

(*a*) "The Huron and Wyandot Cosmogonic Deities and the Iroquoian Sky Gods"; (*b*) "The Wyandot Ukis," by C. M. Barbeau.

"The Clan and the Maternal Family of the Iroquois League," by A. A. Goldenweiser.

"Daily Life of the Southern Pai-Utes Forty Years Ago," by Frederick S. Dellenbaugh.

"The Physical Type of the Burusheki of the Northern Himalaya," by Roland B. Dixon.

"The Eruption and Decay of the Permanent Teeth," by Robert B. Bean. (By title.)

"A Piebald Family of White Americans," by Albert Ernest Jenks.

"Condition Favoring the Development of Totemic Organization," by Franz Boas.

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